WADC TECHNICAL REPORT 57-330
ASTIA DOCUMENT No. AD 131039

INVESTIGATION FOR DETERMINING THE TORQUE-TENSION RELATIONSHIP OF SCREW THREADED FASTENERS USED ON AIRCRAFT

ABRAHAM B. ASCH

ASCH EQUIPMENT COMPANY

JULY 1957

WRIGHT AIR DEVELOPMENT CENTER

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SPECIAL PROJECTS BRANCH
AIRCRAFT LABORATORY
CONTRACT NO. AF 33 (616)-2808
PROJECT NO. 1318
TASK NO. 13444

WRIGHT AIR DEVELOPMENT CENTER
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

Carpenter Litho & Prtg. Co., Springfield, O.
200 – December 1957

FOREWORD

This report, which describes the Torque-Tension Relationships of Screw Thread Fasteners for Aircraft, and the methods used to obtain these relationships, was prepared by Asch Equipment Company of Dayton, Ohio, Order No. P-1227.

This program was performed under Contract No. AF 33(616)-2808, Project No. 1318, Task No. 13444, for the Special Projects Branch WCLSJ-3 of the Aircraft Laboratory, Wright Air Development Center, Mr. A. B. Nutt, Branch Chief, Mr. J. W. Evans, Section Chief and Mr. F. A. Hannon, Project Engineer.

Work on this project was begun on January 28, 1955 and was completed June 21, 1957.

ABSTRACT

This report describes the work done and the results obtained during a program to determine the relationship between the torque required to tighten various types of aircraft bolts and screws and the tensile stress induced in the root area of these bolts and screws by this torque.

The torque-tension relationship was investigated for successive tightenings to high tensile stress levels from the head and nut, with and without lubrication.

The bolts upon which tests were performed were the MS-20,004 to MS-20,024 series (14 sizes), the AN-3C to AN-20C series (13 sizes), and the AN-509-8R to AN-509-916R series flat head screws (8 sizes).

For conditions of dry torquing the torque-tension relationship was found to be a function of many variables; among which were:

1. The type of metal, hardness and surface finish of the plates being bolted.
2. The amount of clearance in the hole drilled to accommodate the bolt.
3. The type of metal, hardness and plated or unplated condition of the bolts and nuts.
4. The geometry and surface finish of the head and nut bearing surfaces.
5. The number of successive tightenings.

Lubricated condition torquing produces average torque-tension relationships which do not vary appreciably over repeated torquings to the high tensile stress levels.

The above listed variables do not play as important a role in the case of lubricated torquing.

The increase in torque value for the dry condition for successive tightenings to the same stress level is due principally to two factors:

1. Galling of the head or nut seating surfaces.
2. Galling of the threads between the nut and bolt.

Preliminary tests indicate that #1 accounts for a considerably greater percentage of the increase in torque values than does thread galling, which suggests a method of partially lubricated torquing.

PUBLICATION REVIEW

The publication of this report does not constitute approval by the Air Force of the findings or conclusions herein. It is published only for the exchange and stimulation of ideas.

FOR THE COMMANDER:

for JAMES O. COBB
Colonel, USAF
Chief, Aircraft Laboratory

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SECTION I

I N T R O D U C T I O N

PURPOSE

The purpose of this contract is to determine the relationship between torque required to tighten various types of aircraft bolts and screws, and the tensile stress induced in the root area of these bolts and screws by this torque.

TEST CONDITIONS

The relationship was investigated for repeated torquings from the head, and from the nut, with and without lubrication. Hardness and surface finish tests were also made for comparison purposes.

BOLTS TESTED

All sizes in the MS-20,004 to MS-20,024 series, the AN-509-8R to AN-509-916R series and the AN-3C to AN-20C series were tested with suitable nuts. All nuts and bolts used were purchased in the open market with the exception of a limited number of nuts furnished by two aircraft manufacturers for comparison purposes.

TEST EQUIPMENT

The tests were performed on a special testing machine designed and built for the purpose, and capable of producing indications of torque and tension simultaneously.

Manuscript released by the author June, 1957 for publication as a WADC Technical Report.

SECTION II

S P E C I M E N S

BOLTS TESTED

Tests were performed on the following bolts and nuts:

Sizes	Bolt	Nut
14	MS-20,004 to MS-20,024	EB
6	MS-20,009 to MS-20,018	42 FW
8	AN-509-8R to AN-509-916R	AN-365
3	AN-509-8R to AN-509-416R	NMJ
9	AN-3C to AN-12C	AN-363-C
4	AN-14C to AN-20C	AN-310-C

Tables 1, 2 and 3, lists the sizes tested and the coded designations.

SPECIMEN IDENTIFICATION

The specimens used for the torque tension tests were identified by a code comprised of letters and digits indicating the following:

The first letter or letters designate the size of the bolt and the type as noted in Tables 1, 2 and 3.

The second digit indicates the specimen number. Five specimens were used for each condition of test.

The third letter is either H or N indicating whether the specimen was torqued from the head or from the nut.

When lubrication was used in testing the specimen, a fourth letter L was added to the code designation.

For example, the specimen E-3-N-L is the third specimen of the MS-20,008 bolt group and was torqued from the nut after the application of lubricant to the threads and to both the nut and head

seating surfaces.

During the course of the test program, several sizes of nuts which were supplied by Lockheed Aircraft Corporation and by Boeing Airplane Company were tested. These nuts were used with bolts F, G, H, I, J and K in the MS-20,009 to MS-20,018 series. These have been further identified in the "Test Data" sheets by the letter A for the nuts supplied by Lockheed and the letter B for the nuts supplied by Boeing. This letter appears before the specimen number.

Appendix I contains the dimensional details of the bolts and nuts used. Figure 1. shows the various types of specimens used.

TABLE 1
MS BOLTS TESTED

MS SERIES BOLTS
YIELD POINT - 140,000 LB/SQ. IN.

CODE No.	AN STANDARD No.	THREAD SIZE	ROOT AREA SQ. IN.	NUT No.
A	MS-20004-42	1/4-28 UNF-3A	0.0326	EB-048
B	MS-20005-50	5/16-24 UNF-3A	0.0524	EB-054
C	MS-20006-50	3/8-24 UNF-3A	0.0809	EB-064
D	MS-20007-50	7/16-20 UNF-3A	0.1090	EB-070
E	MS-20008-50	1/2-20 UNF-3A	0.1486	EB-080
F	MS-20009-50	9/16-18 UNF-3A	0.1888	EB-098 42FW-918
G	MS-20010-50	5/8-18 UNF-3A	0.2400	EB-108 42FW-1013
H	MS-20012-50	3/4-16 UNF-3A	0.3513	EB-126 42FW1216
I	MS-20014-50	7/8-14 UNF-3A	0.4805	EB-144 42FW-1414
J	MS-20016-50	1-14 UNF-3A	0.6464	EB-164 42FW-1614
K	MS-20018-50	1 1/8-12 UNF-3A	0.8118	EB-182 42FW-1812
L	MS-20020-50	1 1/4-12 UNF-3A	1.0237	EB-202
M	MS-20022-52	1 3/8-12 UNF-3A	1.2602	EB-222
N	MS-20024-52	1 1/2-12 UNF-3A	1.5212	EB-242

COMMENTS:
NUTS - ELASTIC STOP NUT CORP. - TYPE EB DOUBLE HEX. HIGH TENSILE EXTERNAL WRENCHING NUTS
STANDARD PRESSED STEEL - 42FW HIGH TENSILE EXTERNAL WRENCHING
(2-EACH USED ON BOLTS - F, G, H, I, J, K)

TABLE 2
AN509 SCREWS TESTED

AN509 SERIES SCREWS
YIELD POINT - 130,000 LB/SQ. IN.

CODE Nº.	AN STANDARD Nº.	THREAD SIZE	ROOT AREA SQ. IN.	NUT Nº.
O	AN509-8R37	8-32 NC-3A	0.0120	AN365-832
P	AN509-10R37	10-32 NF-3A	0.0175	AN365-1032
Q	AN509-416R37	1/4-28 UNF-3A	0.0326	AN365-428
R	AN509-516R48	5/16-24 UNF-3A	0.0528	AN365-524
S	AN509-616R48	3/8-24 UNF-3A	0.0809	AN365-624
T	AN509-716R48	7/16-20 UNF-3A	0.1090	AN365-720
U	AN509-816R49	1/2-20 UNF-3A	0.1486	AN365-820
V	AN509-916R52	9/16-18 UNF-3A	0.1838	AN365-918
W	AN509-8R37	8-32 NC-3A	0.0120	NMJ-82
X	AN509-10R37	10-32 NF-3A	0.0175	NMJ-02
Y	AN509-416R37	1/4-28 UNF-3A	0.0326	NMJ-043

COMMENTS:
"O" THRU "V" - STEEL NUTS - AN365
"W" - "X" - "Y" - ALUM. NUTS - NMJ-82, NMJ-02, NMJ-043 HIGH STRENGTH (ELASTIC STOP NUT CORP.)

TABLE 3
AN-C BOLTS TESTED

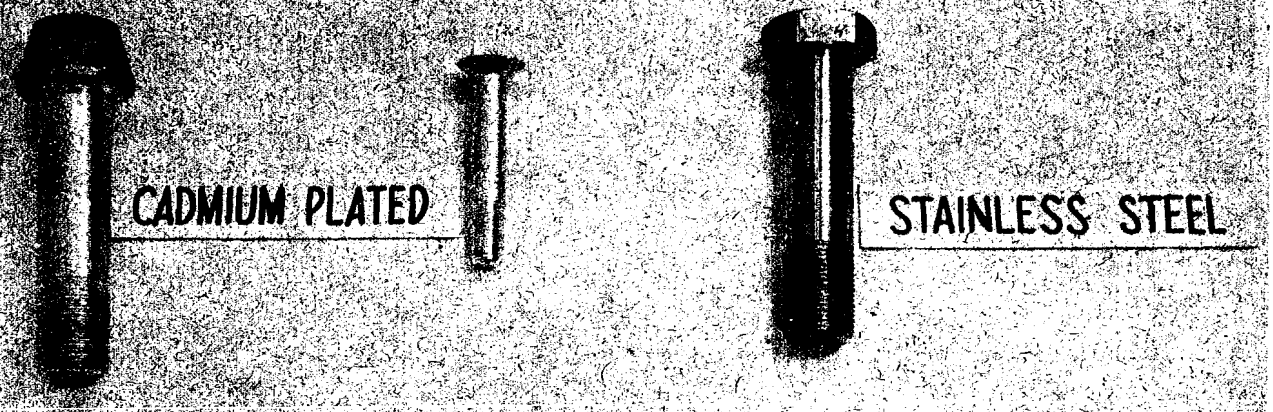
AN SERIES BOLTS
YIELD POINT - 111,000 LB/SQ. IN.

CODE Nº.	AN STANDARD Nº.	THREAD SIZE	ROOT AREA SQ. IN.	NUT Nº.
A-A	AN 3C - 30	10-32 NF-3A	0.0175	AN363C-1032
B-B	AN 4C - 30	1/4-28 UNF - 3A	0.0326	AN363C-428
C-C	AN 5C - 35	5/16-24 UNF - 3A	0.0524	AN363C-524
D-D	AN 6C - 36	3/8 - 24 UNF - 3A	0.0809	AN363C-624
E-E	AN 7C - 36	7/16 - 20 UNF - 3A	0.1090	AN 363C - 720
F-F	AN 8C - 37	1/2 - 20 UNF - 3A	0.1486	AN 363C - 820
G-G	AN 9C - 37	9/16 - 18 UNF - 3A	0.1388	AN 363C - 918
H-H	AN 10C - 37	5/8 - 18 UNF - 3A	0.2400	AN 363C-1018
I-I	AN 12C - 41	3/4 - 16 UNF - 3A	0.3513	AN 363C-1216
J-J	AN 14C - 42	7/8 - 14 UNF - 3A	0.4805	AN310C-14
K-K	AN 16C - 42	1 - 14 NF - 3A	0.6464	AN310C-16
L-L	AN 18C - 44	1 1/8 - 12 UNF - 3A	0.8118	AN 310C-18
M-M	AN 20C - 45	1 1/4 - 12 UNF - 3A	1.0237	AN 310C-20

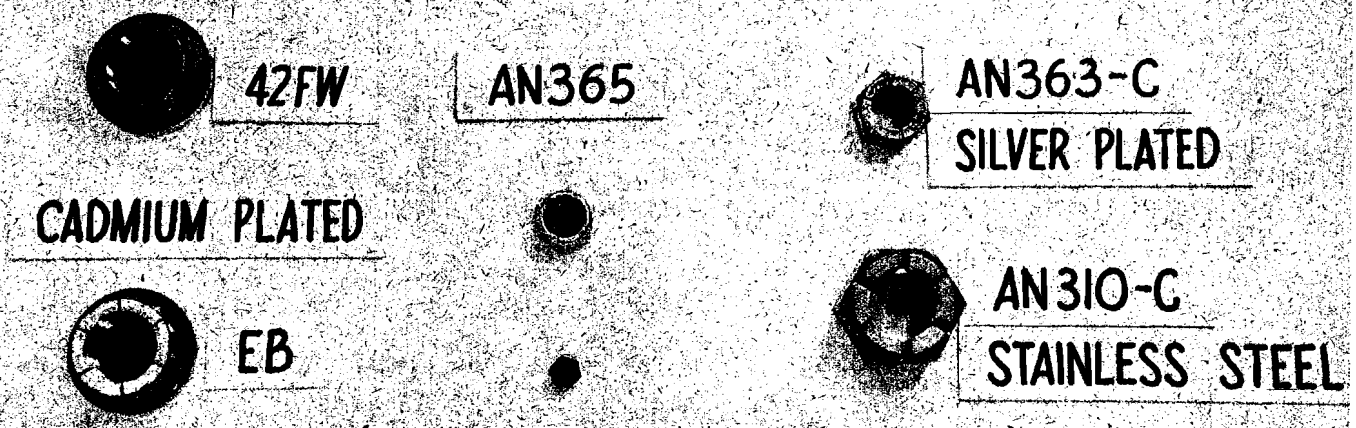
COMMENTS:
NUTS - AN363C - TO 3/4-16 SIZE
ABOVE 3/4-16 USED AN310C

FIG 1

TYPES OF BOLTS TESTED



TYPES OF NUTS TESTED



TYPES OF BOLTS & NUTS TESTED

SECTION III

TESTS AND EQUIPMENT

TORQUE-TENSION TESTS

In order to test the bolt torque-tension relationship, a special testing machine was designed and built. This testing machine incorporates a motorized drive for torquing the bolts. See Fig. 2.

Tension measurements were made by compressing calibrated strain gage load cells with the bolts. Four sizes of load cells were used for the complete range of bolt tension. Calibration of the compression cells was performed on a Tinius-Olsen Compression Tester, with a capacity of 200,000 lbs. Fig. 3 shows the compression cells.

Torsion measurements were made on calibrated torsion load cells. Four sizes were used for the complete range of torsion. Calibration of the torsion cells was performed on a Tinius-Olsen Torsion Tester, with a capacity of 60,000 in. lbs. Fig. 4 shows the torsion cells.

Bolt tension and torsion measurements were read directly from Asch Equipment Company self balancing type strain indicators. See Fig. 2.

The test set up for the different types of bolts are shown in Fig. 5, 6 and 7.

HARDNESS TESTS

Hardness tests were made on several specimens from each type and for each size of the bolts and nuts, and also on representative spacer blocks. These were made on a Rockwell Hardness Tester.

The spacer blocks were countersunk to allow clearance for the fillets under the heads of the MS-20,004 to MS-20,024 series bolts,

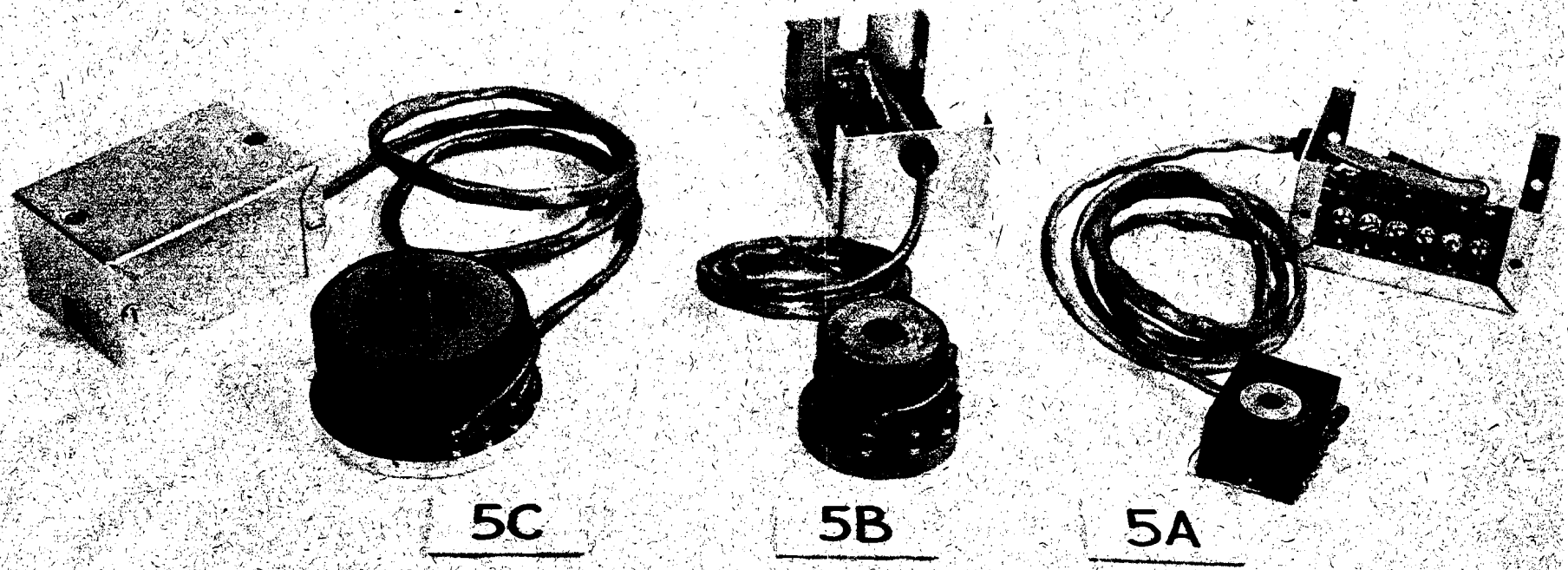
and the AN-3C to AN-20C series bolts, and also for the flat heads of the AN-509-8R to AN-509-916R series screws. Contours are shown on the "Test Data" sheets in Appendix III. The spacer blocks used with the nuts were not countersunk. Spacer blocks are shown in Fig. 8.

SURFACE FINISH TESTS

Tests were also performed on the same specimens for finish of the seating surface of the heads and the nuts where they contact the spacer blocks, and also of the bearing surface of the spacer blocks. A Profilometer was used for these tests. Prior to making the tests, the Profilometer used was calibrated against known standards and found to be indicating 75% of the R.M.S. values. In the data sheets a correction factor of 1.33 was applied to the Profilometer readings.

FIG 7
BOLT TESTING MACHINE

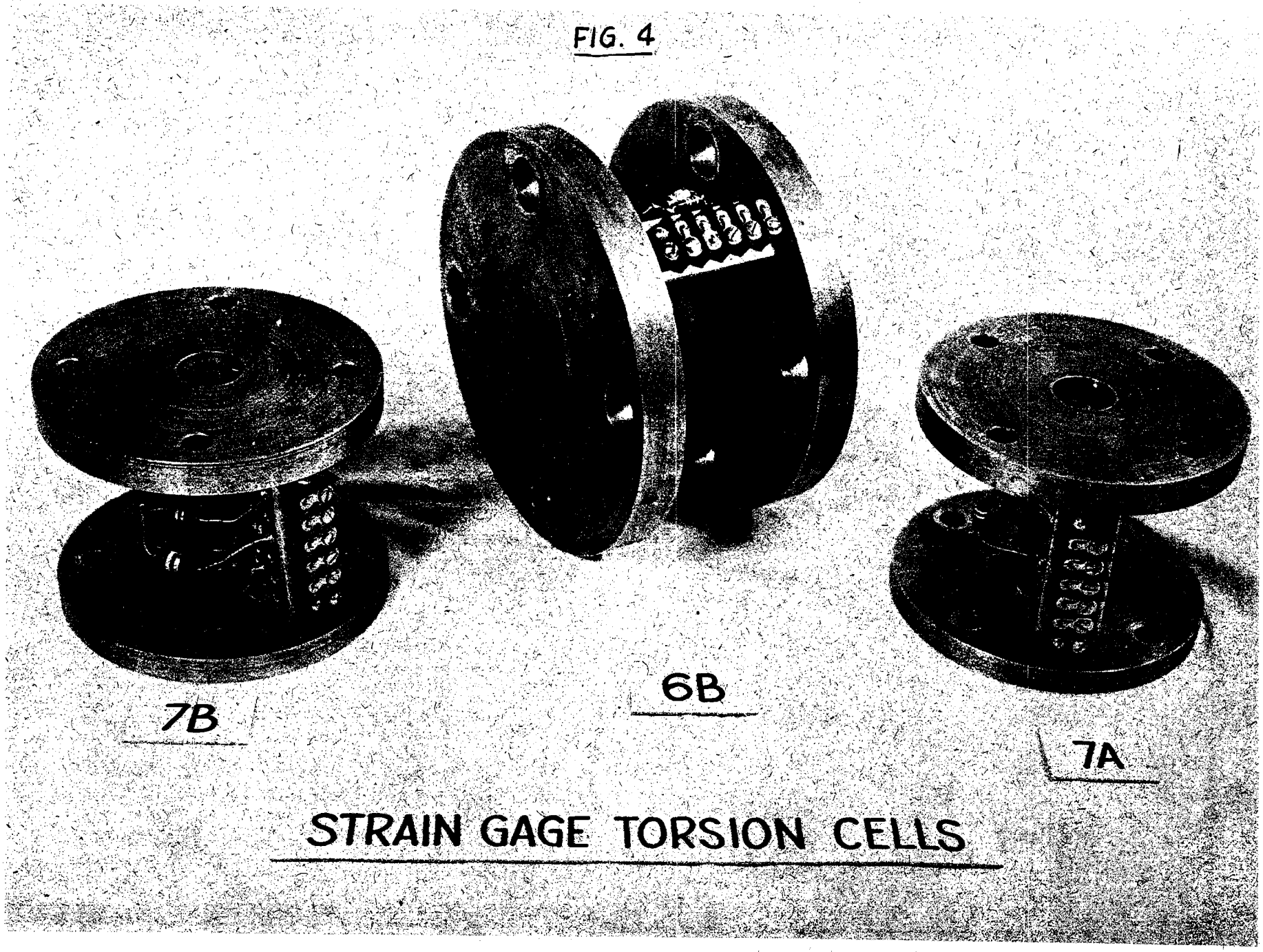
FIG. 3



5C 5B 5A

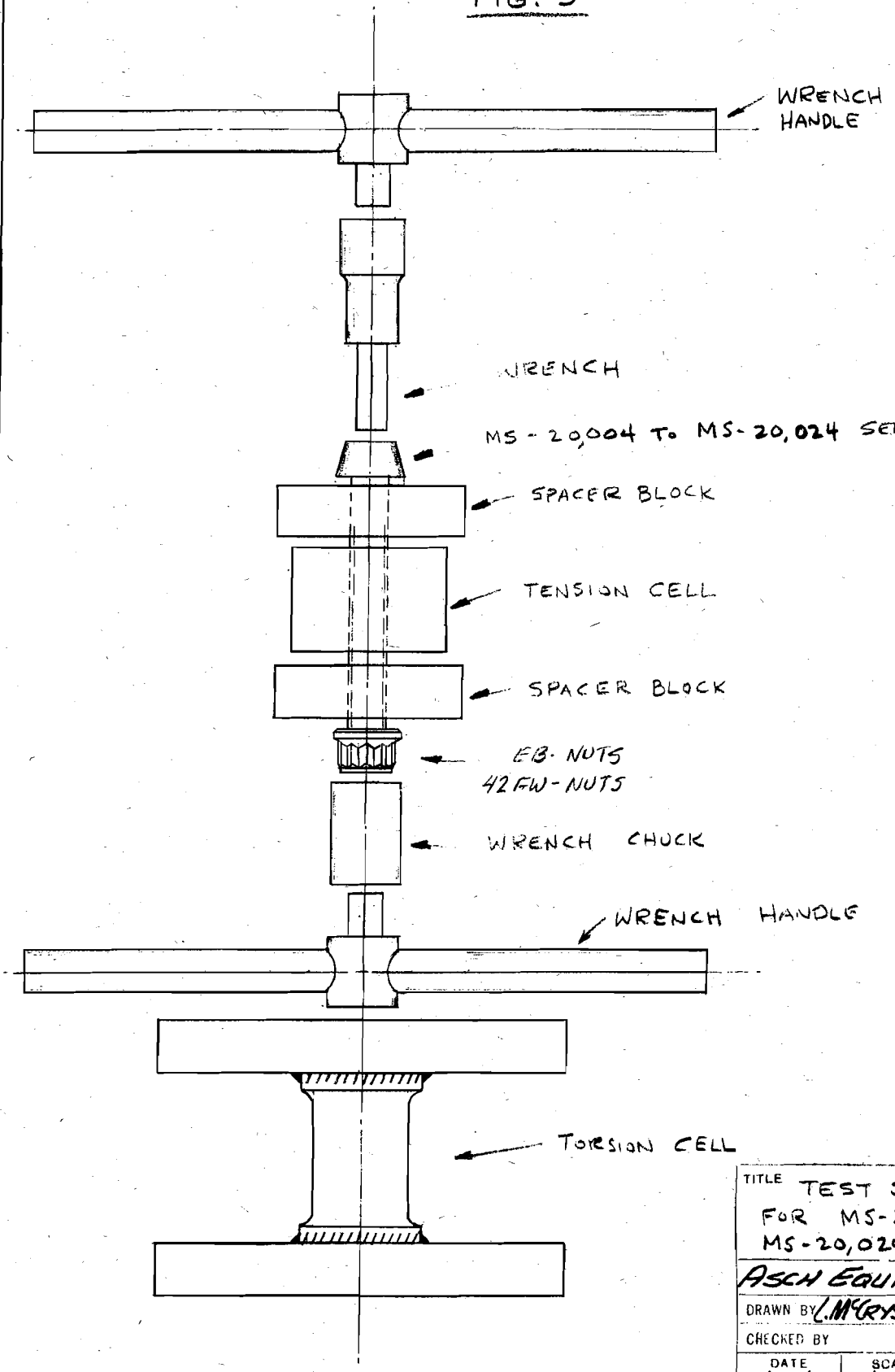
STRAIN GAGE COMPRESSION CELLS

FIG. 4



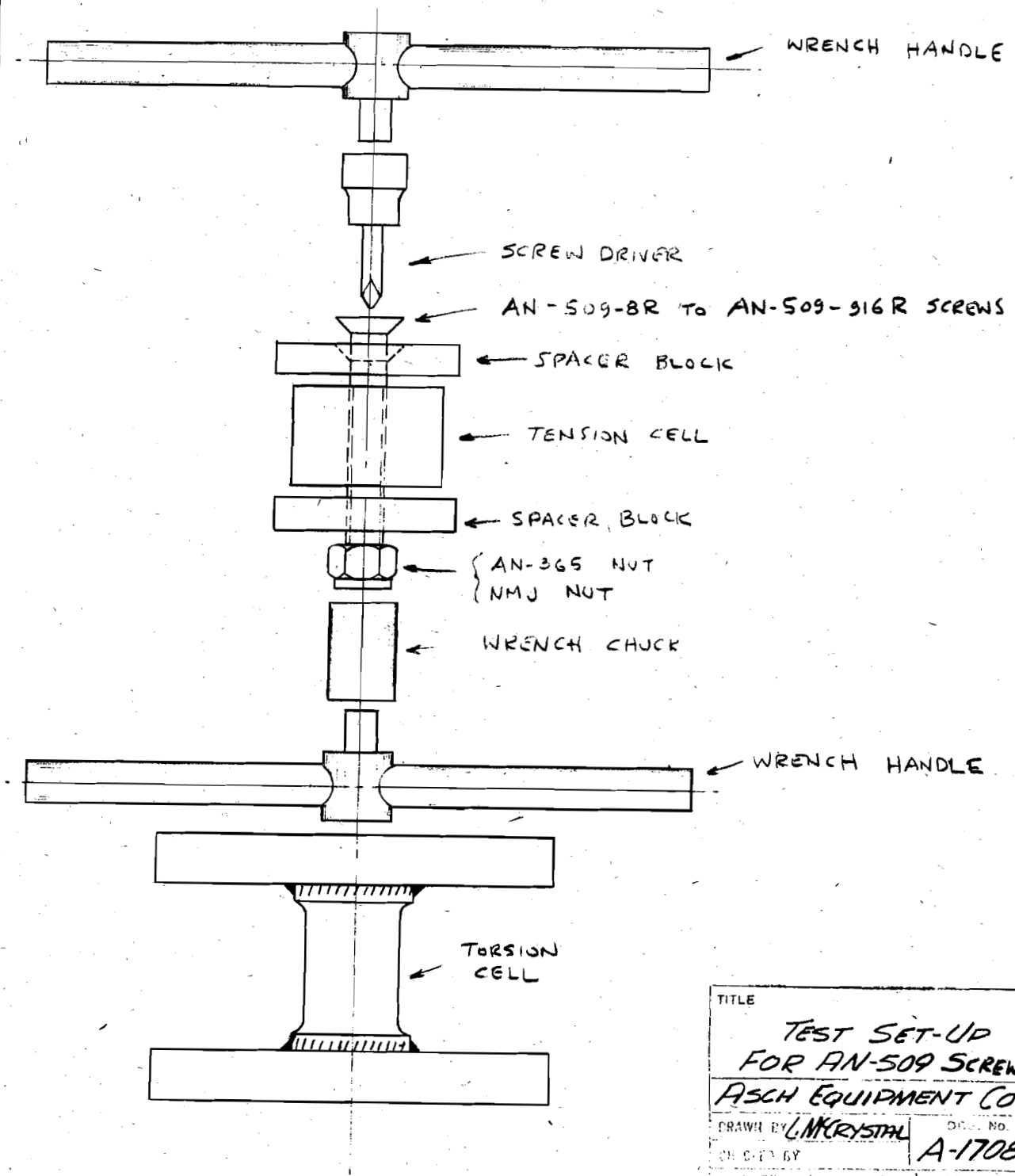
STRAIN GAGE TORSION CELLS

FIG. 5



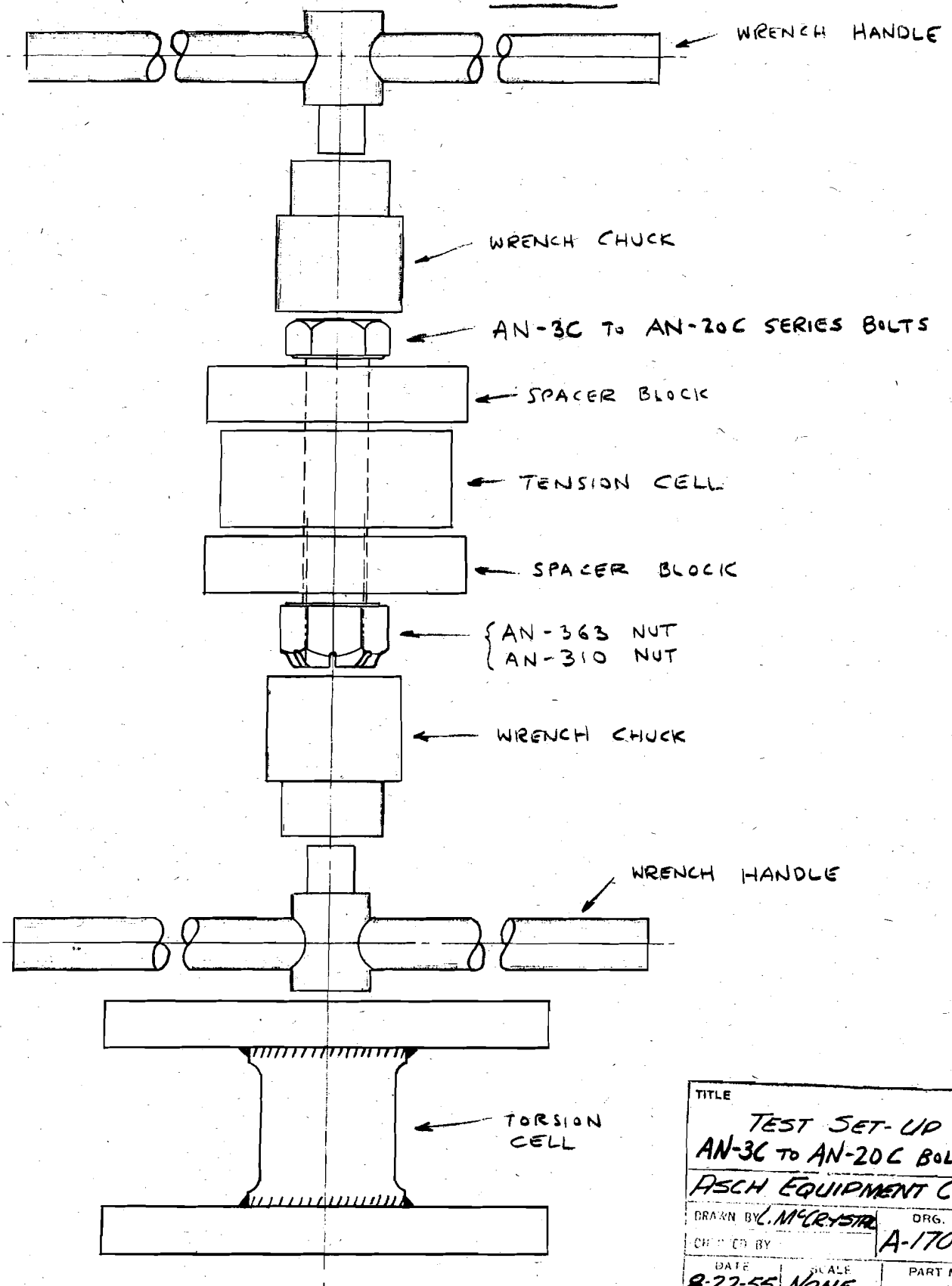
TITLE	TEST SET UP FOR MS-20,004 TO MS-20,024 SERIES BOLTS
	ASCH EQUIPMENT CO.
DRAWN BY	L. McCRYSTAL
CHECKED BY	
ORG. NO.	A-1706
DATE	8/22/55
SCALE	NONE
PART NO.	

FIG. 6



TITLE	TEST SET-UP FOR AN-509 SCREWS
	ASCH EQUIPMENT CO.
DRAWN BY L. McCRYSTAL	DWG. NO. A-1708
CHECKED BY	
DATE 8-22-55	SCALE NONE
	PART NO.

FIG. 7



TITLE	TEST SET-UP AN-3C TO AN-20C BOLTS
	ASCH EQUIPMENT CO.
DRAWN BY	L. McCRYSTAL
CHECKED BY	
DRG. No.	A-1707
DATE	8-22-55
SCALE	NONE
PART No.	

FIG. 8

SECTION IV

PRELIMINARY TESTING

TESTS OF TORQUING METHODS

Initial experimental tests were made using AN-4C-30, 1/4-28 UNF-3A stainless steel bolts and AN-363-C428 silver plated steel nuts.

In these tests the compression recording strain gage cell was sandwiched between cold rolled steel spacer blocks drilled to accommodate the 1/4" diameter AN bolts. Bolts were torqued in the dry condition from the nut.

Two methods of obtaining torque-tension data for multiple torquings of the individual bolt-nut combinations were investigated.

1. Torquing the bolts to a maximum tension value (less than that causing bolt yield) in six uniform steps, returning to zero tension and repeating the sequence five times.

2. Torquing the bolts from zero tension to the first of six uniform steps five times in succession and repeating for each higher tension point up to the maximum tension.

Torquing to each tension value five times before proceeding to the next, required greater values of torque at the higher tension loads than did the method of torquing the bolt from minimum to maximum tension five times in succession. The spread between individual torque values for the same bolt tension, however, was not as great using method #2.

It was decided that method #1 would be adopted for the test program for the reason that torquing by this method was more representative of actual field conditions than method #2.

It was observed that the torque required for the same tension in the bolt over repeated runs increased greatly due to galling

and scarring of the steel spacer blocks. Also, the initial run of each new bolt-nut combination increased over that of the previous combination as the surface of the spacer block became progressively rougher.

TESTING THE EFFECT OF WASHERS

In an effort to obtain more consistent results from bolt to bolt, hardened steel washers were inserted between the bearing surfaces of nut and bolt head and the steel spacer blocks. These washers, however, turned on the spacer block with the nut and caused the same galling conditions as did the nut turning directly on the spacer block.

Pinning the hardened washers to the spacer block proved unsatisfactory due to breakage of the brittle washers during the test runs.

TESTS TO EVALUATE HEAD & NUT BEARING FRICTION

In order to isolate the torque required to overcome thread friction from the torque required to overcome the friction of the nut and spacer block bearing surfaces, an AN-200-KP-4 ball bearing was mounted in the steel spacer block. The nut turned freely on the inner race of the ball bearing during these torque-tension tests. For this arrangement smaller torque values than previously observed were required to obtain the desired tension values in the bolts. After sixteen repeated dry torquing runs on the same bolt-nut combination the torque required to obtain the same tension in the bolt did not increase perceptibly. Thus for this bolt and nut combination the increase in thread friction due to repeated tightenings was negligible, indicating that the additional torque required for repeated tightenings, and successive bolts during previous tests was due principally to the worsening condition of the bearing surface of the steel spacer blocks, and nuts or heads.

TESTS WITH HARDENED SPACER BLOCKS

Since the surface condition of the cold rolled steel spacer blocks seemed to be the determining factor in the torque-tension relationship, and their reuse resulted in such wide fluctuations, it was decided to use SAE-01 tool steel blocks hardened to Rockwell C-60 for the test program. It was expected that in this way each new bolt would be subject to the same conditions as the previous one without necessitating the use of a new set of spacer blocks for each individual bolt-nut test specimen. Although the hardened blocks were a distinct improvement over the cold rolled steel blocks, it was found that even the hardened blocks were subject to galling and smearing of metal, and required sanding.

Experimental tests using hardened steel (Rockwell C-60) spacer blocks and the following bolts and nuts were made.

BOLTS: (1) AN8C-37, 1/2-20 UNF-3A Stainless Steel Bolt.

(2) 1/2" Diameter Standard Cold Finished Steel Bolt.

NUTS: (1) AN-363-C820, 1/2" Silver Plated Steel Nut.

(2) 1/2" Standard Cold Finished Steel Nut.

These tests involved successive dry torquings from the nut for the various combinations of the above bolts and nuts, and torquings with the nut bearing surfaces alone lubricated with oil; with the threads alone lubricated with oil, and with both the thread and nut bearing surfaces lubricated with oil.

As a result of these tests the following conclusions were reached:

1. The increase in the torque requirements for successive tightenings of the same bolt-nut combination is due to the following factors:

   (a) Increased friction between bearing surfaces of nut and hardened steel spacer block due to galling.

(b) Increased friction between threads of the nut and bolt due to galling.

2. Factor (a) above accounts for a much greater percentage of the increased torque required after successive tightenings for the combinations tested.

3. A silver plated nut causes less galling of the hardened steel spacer block than does a standard steel nut. Silver plating acts like a lubricant in this respect.

4. The increase in torque values over successive dry tightenings of the stainless steel bolt and silver plated nut due to thread friction is negligible for as many as six torquings.

5. For the standard steel bolt used with the silver plated nut, or for the stainless steel bolt used with the standard steel nut the increase in torque values over successive dry tightenings is partially attributable to increased thread friction. That portion of the increased torque due to the increase in thread friction, however, is only about 10 to 20% of the total, the rest being due principally to the increased friction of the nut and spacer block bearing surfaces due to galling.

SECTION V

TEST PROCEDURES

TORQUE-TENSION TESTS

Torque-tension tests were performed in the following order:

1. Torqued from nut - Lubricated
2. Torqued from head - Lubricated
3. Torqued from nut - Dry
4. Torqued from head - Dry

Each bolt specimen was torqued through its full range for five successive torquings before the next specimen was tested. All tests were made at room temperature. Readings were made as torque was increased. No determination was made of the torque due to the self locking provisions in the nuts at zero tension load. No release torque readings were made.

Torque values were recorded on the test data sheets for six increasing stress levels, wherever possible. On the fifth torquing the stress was raised to the computed yield point where possible, and the torque noted. In many cases principally during dry torquing from the head, the bolt failed before the higher tensile stress levels could be reached.

LUBRICATED TORQUING

For the lubricated condition tests, thread compound, anti-seize, graphite petrolatum, Mil-T-5544 lubricant, which is a mixture of 50% graphite and 50% petrolatum, was applied to the threads and to the seating surfaces of the bolt heads and nuts prior to the initial torquing.

Lubrication was also applied during subsequent torquings due to loss of lubricant. The initial lubrication and subsequent lubrications

are noted in the "Test Data" sheets by an "L" placed before the torquing runs where they were applied.

For the MS-20,004 to MS-20,008 series bolts and the AN-3C to AN-8C series bolts, the seating surface of the spacer blocks had a ground finish at the start of the tests for each size bolt. No polishing or sanding was done on these surfaces during the lubricated torquing tests.

For the AN-509-8R to AN-509-816R series bolts, the finish was that left by the countersink tool at the start of the tests for each size bolt, and the surface was not processed in any way during the lubricated torquing tests.

For lubricated tests on the MS-20,009 to MS-20,024 bolts and for the AN-9C to AN-20C bolts, and for the AN-509-916R screws, the seating surfaces of the spacer blocks were sanded after the fifth torquing of each bolt as described under dry torquing.

DRY TORQUING

After completing the lubricated tests on a bolt size, the blocks and the specimens were thoroughly cleaned with carbon tetrachloride before dry torquing was begun.

It was found that the pressure of the seating surfaces of the bolts and nuts during dry torquing, deposited an increasing amount of metal and plating on the seating surfaces of the spacer blocks.

For this reason the bearing surface of the blocks were sanded after the fifth torquing on each bolt. Thus tests on each new specimen was started on a newly sanded surface. For the MS-20,004 to MS-20,024 series and the AN-3C to AN-20C series bolt spacers, and for the spacers used with the nuts of the AN-509-8R to AN-509-916R series

screws this was done on a belt sander using a "100-X Grit Metallic Cloth" manufactured by Behr Manning of Troy, New York. For the AN-509-8R to AN-509-916R series bolt spacers used with the screw heads, this was done by hand sanding the countersunk area.

The "Test Data" sheets on finish show the Profilometer readings of these surfaces.

HARDNESS TESTS

Hardness tests on the bolts were made by grinding a flat on the shank of the bolt. Tests on the nuts were made on the flats for hexagon nuts and on the seating surface for the EB and 42FW type nuts. Spacer blocks hardness tests were made on the seating surfaces.

SURFACE FINISH TESTS

Tests for surface finish were made on the spacer blocks in a direction across the cutting tool marks. In the case of the bolt and nut seating surface this was in a radial direction. For a few small sizes it was necessary to depart from the radial somewhat to clear the shank of the bolt.

SECTION VI

TEST RESULTS

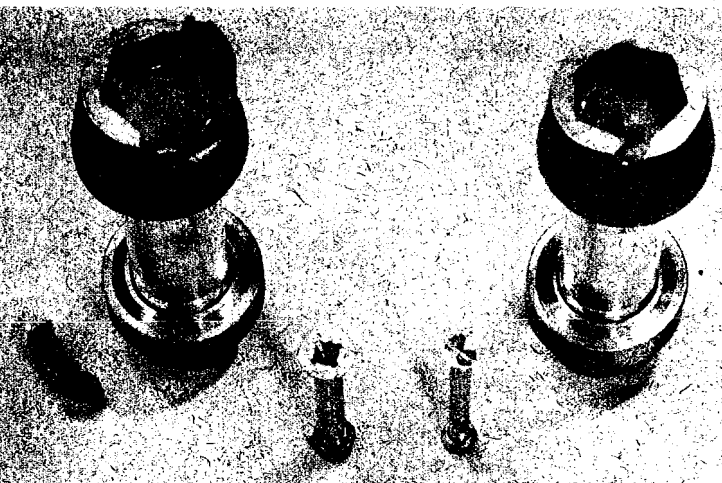
Appendix II contains the data on the hardness and surface finish of the bolt heads, the nuts, and the spacer blocks.

Appendix III contains the "Test Data" sheets showing the torque-tension test results obtained with the various bolts and nuts for the different test conditions.

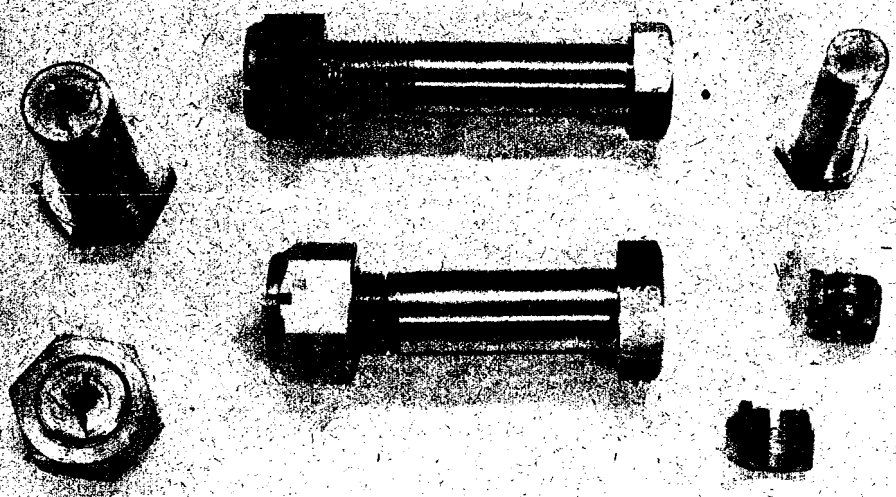
Appendix IV contains graphs of the relationship between the average torque and the tension for the various types and sizes of bolts, for the different conditions of test. Plot lines connect average points directly, without curve fitting. On Pages 166 to 175 are shown related families of curves for the various types of bolts tested.

FIG. 9

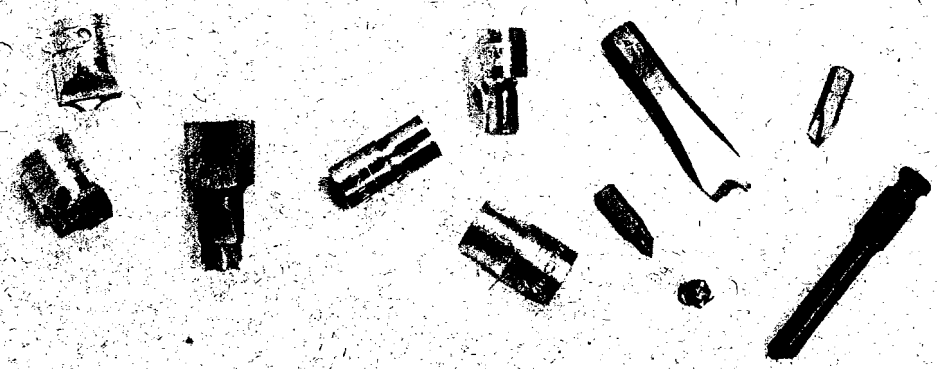
EXAMPLES OF TEST SPECIMEN & TOOL FAILURES



BOLT HEAD RECESS RUPTURE



BOLT FAILURE IN SHEAR AT ROOT DIAMETER



DRIVING TOOL FAILURES

SECTION VII

C O N C L U S I O N S

LUBRICATED TORQUING

Lubricated condition torquing produces average torque-tension relationships which do not vary appreciably over repeated torquings to the high tensile stress levels.

The torque tension relationship varies with different lubricants. Specification Mil-T-5544 lubricant possesses outstanding anti-friction and anti-seize properties, and lower torque values were required to produce a given tension than other lubricants tried.

DRY TORQUING

The torque required to produce a certain tension in the bolts increased with each successive dry torquing, due principally to the progressive deterioration of the bearing surfaces under the head or nut.

A study of the data sheets indicates that the socket heads on the MS-20,004 to MS-20,024 series bolts, and the Phillips, Frearson and screwdriver slots on the AN-509-8R to AN-509-916R series screws, do not develop the full tension capabilities of these bolts and screws under conditions of dry torquing. In most cases the higher tensile stresses were not reached due to rupture of the heads by torquing.

In the case of the AN-3C to AN-20C series bolts, this tendency to rupture the head was not evident, except in some isolated cases.

For the case of the AN-3C to AN-12C series bolts, the torque from the head was 50 to 100% greater than the torque from the silver plated nut, indicating the effectiveness of the plating.

TORQUE VARIATIONS AMONG INDIVIDUAL BOLTS

The torque tension relationship among individual bolts of the same size in a series, showed an average variation from the mean of about ± 18% for both the dry and lubricated cases; with the exception of the dry torquing case for the MS-20,004 to MS-20,024 series bolts where the average variation was about 26%. These percentages were based on a 7% sample of all the results.

EFFECT OF CLEARANCE HOLES ON SPACER BLOCKS

It was observed that torque values obtained during the dry torquing tests were dependent to a noticeable extent on the size of the clearance holes drilled in the spacer blocks to accommodate a particular diameter bolt. As the diameter of the hole is enlarged, the torque required increases also; due to the reduced bearing surface area, which increases the friction, galling and seizing between bolt head or nut and the spacer block. See galling areas on blocks in Fig. 8.

The torque data obtained during this test program thus pertains to the bolting of hardened steel plates through holes, which have the specific clearances noted on the "Data Sheets". See Appendix III. The relationships for other sizes of clearance holes were not investigated.

BEARING CONTACT AREA OF HEADS & NUTS

Due to the fact that in most cases the bearing surfaces of both bolt heads and nuts are not formed flat and perpendicular to the bolt axis, the actual contact area is considerably different from that calculated from the dimensions shown on the specification sheets.

The heads of the AN-509-8R to AN-509-916R series flat head screws also do not fully contact the countersunk area of the spacer blocks. In most cases it is estimated that approximately 60% of the calculated bearing surface area was utilized.

EFFECT OF PLATING

Silver or cadmium plating on a bolt or nut acts as an anti-seize with regard to lowering the required torque values for the dry con-

ditions. Silver plating appears to be superior to cadmium plating with regard to its anti-seize effect. Under lubricated torquing conditions the effect of the plating on the torque required is greatly reduced.

Values of torque for dry nut torquing of the AN type bolts employing silver plated nuts may vary from lot to lot and from manufacturer to manufacturer, as a function of pre-plating surface finish, thickness of plating deposited, and plating techniques.

EFFECT OF DYED ALUMINUM NUTS

After plotting the data obtained from the AN-509-8R to AN-509-416R series screws with the NMJ aluminum nuts it was observed that for the case of dry torquing the curves did not follow the spread pattern obtained with the AN-365 silver plated steel nuts on the same size screws. Also the torque values were less. Compare graphs of bolts O, P and Q with W, X and Y.

These torque values were increased many fold when the blue dyed NMJ aluminum nuts were allowed to soak in carbon tetrachloride for about five minutes prior to testing. See graph of size X test bolt, Page 151.

The manufacturer of the blue dyed aluminum nuts later advised that these aluminum nuts were dyed blue for identification purposes only. During the process, the nuts are impregnated with a lubricant and are not subject to any subsequent bath or rinse that might tend to remove the lubricant.

The normal test procedure of wiping the nuts with carbon tetrachloride was not sufficient in this case to completely remove the lubricant and the results of the dry torquing test for bolts W, X and Y must be considered as having been modified by the manufacturers lubricant.

STAINLESS STEEL BOLTS & NUTS

Tests on the AN-14C to AN-20C type bolts, of 7/8" diameter to 1 1/4" diameter were run with AN-310 type unplated stainless steel nuts. The friction on the stainless steel threads between bolt and nut caused seizure and consequent failure of the bolt in shear at the root area during dry torquings at values of tension from 40-60,000 psi. See examples of specimen failures shown in Fig. 9.

The higher torque values attributable to thread friction appears to be due to the galling and seizing action caused by the use of stainless steel for both the bolt and the nut. This severe galling effect at the threads was not evident when both metals were dissimilar or one or both were plated.

SOCKET HEAD RUPTURE

The recessed socket heads of the MS-20,004 to MS-20,024 type bolts ruptured before reaching the higher stress levels, when torquing from the head in the dry condition. Sizes between 1/2" diameter and 1 1/4" diameter ruptured out when torquing from the head in the dry condition at values of tension around 50,000 psi. With the 1 1/4" diameter and 1 1/2" diameter bolts under the same conditions, it was possible to torque to 70,000 psi. before rupture occurred.

Rupturing of the recessed head also occurred with the AN-509 flat head screws above 1/4" diameter, at values of 30,000 psi. or less. See Fig. 9.

DRIVE TOOL FAILURES

In many cases, particularly with the AN-509 screws the best drive tools commercially available ruptured before the bolts could be torqued to the yield point. Some of these broken tools are shown in Fig. 9.

CONCLUSION

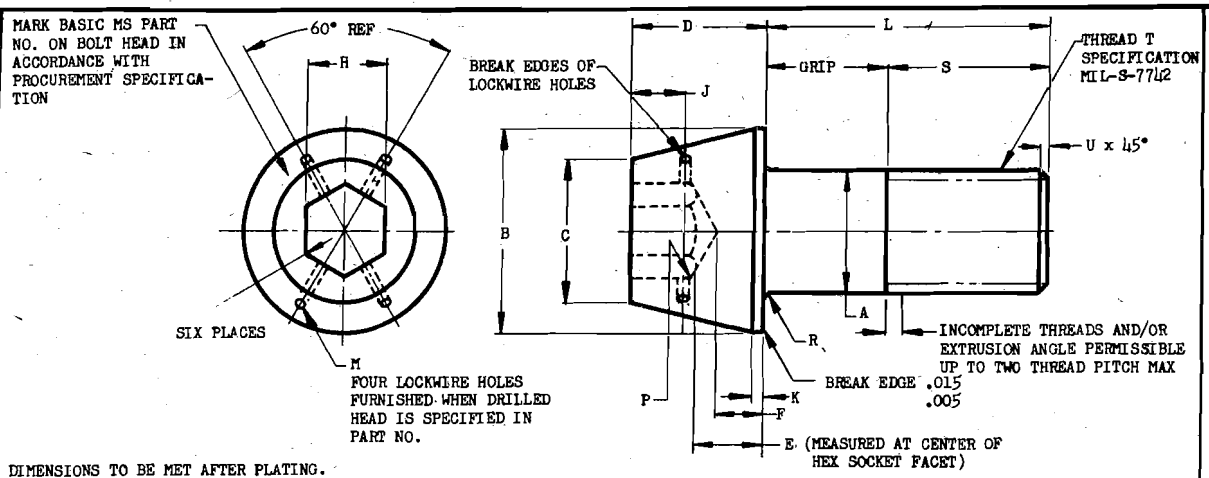
The torque-tension relationships as determined during these tests, must be regarded as applying only for the particular conditions of these tests. It was found that the bearing surfaces of the objects bolted together exercised considerable influence on the results obtained. Thus for spacers of other materials, with other hardness and finish treatment, and with different clearance in the bolt holes, other torque-tension relationships would be expected. The variance affects of these conditions are greatly magnified for the case of dry torquing.

In view of the much greater repeatability of lubricated torquing relationships, it would appear that this method would be preferred for pre-stressing, subject to a possible reduction in locking and holding resistance of the nut due to the thread lubrication.

During the preliminary tests, it was noted that most of the scatter and increase during torquing conditions was due to the nut or the head bearing surface friction and seizure. In view of this, a torquing procedure might be considered in which the lubricant is applied only under the nut or head, whichever is used for torquing, without lubricating the threads. This method would improve consistency of results over the totally dry case, and at the same time maintain the full locking resistance of the thread.

APPENDIX I

DIMENSIONAL DETAILS OF BOLTS TESTED



DIMENSIONS TO BE MET AFTER PLATING.

BASIC MS PART NO.	(a) THREAD T	(a) A DIA	(a) B DIA	(a) C DIA	D	E	F MIN	(a) H	J	K	M +.005 -.000 DIA	N MAX RAD	P RAD	R RAD	(b) S REF	U ±.016	(a) CONCENTRICITY X	Y	Z
MS20004	1/4 -28UNF-3A	.2492 .2477	.438 .428	.342	.250	.112	.068	.1900 .1880	.078	.063	.037	.010	.020 .010	.041 .031	.500	.031	.005	.007	.0045
MS20005	5/16-24UNF-3A	.3117 .3102	.531 .521	.394	.312	.144	.094	.2210 .2190	.094	.063	.055	.010	.020 .010	.041 .031	.562	.047	.006	.008	.0045
MS20006	3/8 -24UNF-3A	.3742 .3727	.649 .639	.520	.375	.183	.116	.3150 .3130	.125	.063	.055	.011	.020 .010	.057 .047	.688	.047	.008	.010	.0045
MS20007	7/16-20UNF-3A	.4367 .4347	.750 .740	.534	.438	.208	.141	.3150 .3130	.156	.063	.055	.011	.020 .010	.057 .047	.812	.047	.009	.011	.006
MS20008	1/2 -20UNF-3A	.4991 .4971	.828 .818	.625	.500	.247	.169	.3785 .3755	.172	.063	.055	.011	.020 .010	.057 .047	.812	.047	.010	.012	.006
MS20009	9/16-18UNF-3A	.5616 .5596	.938 .928	.723	.562	.279	.190	.4410 .4380	.203	.094	.055	.011	.020 .010	.057 .047	.875	.062	.011	.014	.006
MS20010	5/8 -18UNF-3A	.6240 .6220	1.050 1.040	.826	.625	.317	.216	.5035 .5005	.234	.094	.055	.019	.020 .010	.073 .063	.938	.062	.012	.016	.006
MS20012	3/4 -16UNF-3A	.7488 .7468	1.230 1.220	.921	.750	.385	.273	.5660 .5630	.281	.094	.055	.022	.030 .015	.073 .063	1.062	.062	.015	.018	.006
MS20014	7/8 -14UNF-3A	.8737 .8707	1.438 1.428	1.083	.875	.450	.327	.6295 .6257	.344	.094	.055	.022	.030 .015	.073 .063	1.188	.078	.018	.022	.009
MS20016	1 -14 NF-3A	.9985 .9955	1.625 1.615	1.249	1.000	.527	.381	.7547 .7507	.391	.094	.055	.022	.030 .015	.073 .063	1.312	.078	.020	.025	.009
MS20018	1-1/8 -12UNF-3A	1.124 1.121	1.875 1.865	1.275	1.125	.589	.443	.7547 .7507	.453	.094	.055	.022	.030 .015	.073 .063	1.500	.094	.022	.026	.009
MS20020	1-1/4 -12UNF-3A	1.249 1.246	2.125 2.115	1.598	1.250	.667	.475	1.005 1.001	.500	.125	.055	.022	.030 .015	.089 .077	1.625	.094	.025	.032	.009
MS20022	1-3/8 -12UNF-3A	1.374 1.370	2.313 2.303	1.768	1.375	.746	.531	1.131 1.126	.547	.125	.055	.022	.030 .015	.089 .077	1.750	.094	.028	.035	.012
MS20024	1-1/2 -12UNF-3A	1.499 1.495	2.500 2.490	1.931	1.500	.823	.586	1.256 1.251	.594	.156	.055	.022	.030 .015	.089 .077	1.875	.094	.030	.039	.012

(a) DIMENSIONS A, B, AND C SHALL BE CONCENTRIC TO EACH OTHER WITHIN VALUES SPECIFIED FOR X TOTAL INDICATOR READING.
DIMENSIONS H AND C SHALL BE CONCENTRIC TO EACH OTHER WITHIN VALUES SPECIFIED FOR Y TOTAL INDICATOR READING.
DIMENSIONS A AND THREAD PITCH DIAMETER SHALL BE CONCENTRIC TO EACH OTHER WITHIN VALUES SPECIFIED FOR Z TOTAL INDICATOR READING.

(b) REFERENCE DIMENSIONS ARE FOR DESIGN PURPOSES ONLY AND ARE NOT AN INSPECTION REQUIREMENT.

MATERIAL: ALLOY STEEL. SEE PROCUREMENT SPECIFICATION.

FINISH: CADMIUM PLATE. SEE PROCUREMENT SPECIFICATION.

HEAT TREAT: SEE PROCUREMENT SPECIFICATION.

ADD H BEFORE DASH NO. FOR BOLT WITH DRILLED HEAD.

EXAMPLES OF PART NOS.: MS20004-8 = 1/4-28 BOLT, 1.000 INCH LONG, .500 INCH GRIP, UNDRILLED HEAD.
MS20004H8 = 1/4-28 BOLT, 1.000 INCH LONG, .500 INCH GRIP, DRILLED HEAD.
MS20004-9 = 1/4-28 BOLT, 1.062 INCH LONG, .562 INCH GRIP, UNDRILLED HEAD.
MS20004H9 = 1/4-28 BOLT, 1.062 INCH LONG, .562 INCH GRIP, DRILLED HEAD.

BOLTS SHALL BE FREE FROM ALL HANGING BURRS AND SLIVERS WHICH MIGHT BECOME DISLODGED UNDER USAGE. COUNTERSINKING OF DRILLED HOLES IS OPTIONAL.

DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: DECIMALS ±.010, ANGLES ±1°.

APPROVED 28 Jan 52 REVISED

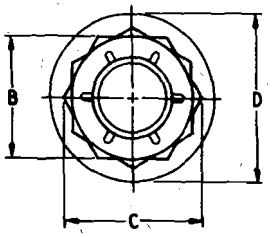
CUSTODIAN Navy - Buaer	MILITARY STANDARD	MS20004 THRU MS20024
PROCUREMENT SPECIFICATION MIL-B-7838	BOLT - INTERNAL WRENCHING, 160,000 PSI	SHEET 1 OF 2

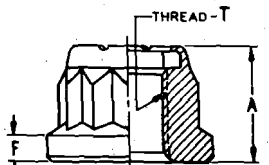
OTHER INTEREST: AIR FORCE

SUPERSEDES DRAWING NAS495

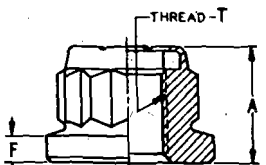
81 48178

ESNA ELASTIC STOP NUT CORPORATION OF AMERICA, UNION, NEW JERSEY.





PROFILE OF FORGED NUT BODY



PROFILE OF FULLY MACHINED NUT BODY

ESNA PART NUMBER	THREAD T	A	B	C MIN	D +.000 -.010	F	ULTIMATE TENSILE STRENGTH LB MIN (SEE PERFORMANCE)	APPROX WEIGHT LB/100	AVAILABILITY
EB-048	1/4-28NF-3	.344	.377 .362	.409	.531	.090	7,132	1.00	*
EB-054	5/16-24NF-3	.406	.439 .424	.479	.593	.090	11,322	1.40	*
EB-064	3/8-24NF-3	.453	.503 .488	.551	.687	.099	16,876	2.00	*
EB-070	7/16-20NF-3	.516	.565 .550	.622	.781	.107	22,892	2.80	*
EB-080	1/2-20NF-3	.563	.628 .612	.692	.875	.118	30,555	3.50	*
EB-098	9/16-18NF-3	.625	.691 .675	.763	.968	.127	34,800	4.50	*
EB-108	5/8-18NF-3	.672	.785 .769	.870	1.062	.136	44,200	6.40	*
EB-126	3/4-16NF-3	.781	.943 .927	1.049	1.250	.185	64,700	11.00	*
EB-144	7/8-14NF-3	.953	1.067 1.050	1.188	1.438	.219	88,400	15.00	*
EB-164	1-14NF-3	±.031 1.125	1.194 1.177	1.331	1.625	.328	119,000	25.00	*
EB-182	1 1/8-12NF-3	±.031 1.296	1.382 1.365	1.543	1.875	.438	150,000	36.00	†
EB-202	1 1/4-12NF-3	±.031 1.406	1.507 1.490	1.685	2.125	.500	189,000	50.00	†
EB-222	1 3/8-12NF-3	±.031 1.531	1.633 1.616	1.830	+.000 -.020 2.313	.562	233,000	62.00	Δ
EB-242	1 1/2-12NF-3	±.031 1.656	1.821 1.804	2.048	+.000 -.020 2.500	.656	281,400	85.00	Δ

CODE: PART NUMBER DESIGNATES DOUBLE HEX HIGH TENSILE NUT AS SPECIFIED IN TABULATION ABOVE.

EXAMPLE: EB-064 = DOUBLE HEX, HIGH TENSILE NUT, TYPE EB, 3/8-24 THREAD.

③MATERIAL: STEEL - AISI 4130 (AMS 6370) OR EQUIVALENT, THREAD SIZES 1/4 THROUGH 1/2.
STEEL - AISI 3140 OR EQUIVALENT, THREAD SIZES 9/16 THROUGH 1.
STEEL - AISI 4340 (AMS 6415) OR EQUIVALENT, THREAD SIZES 1 1/8 AND LARGER.

FINISH: CADMIUM PLATE - FEDERAL SPEC QQ-P-416, TYPE I, CLASS C.

③LOCKING INSERT: RED NYLON - "ZYTEL" 101.

HARDNESS: ROCKWELL "C" 29-35. (SEE NOTE 1).

MAGNETIC PARTICLE INSPECTION: PARTS INDIVIDUALLY INSPECTED IN ACCORDANCE WITH MILITARY SPECIFICATION MIL-I-6868 AND DYED GREEN.

ISSUED: 5 JAN 51 REVISED: ②30 DEC 53 ③12 NOV 54

EB 1

PERFORMANCE SPECIFICATION	ESNA - STANDARD	
NAS353 AS APPLICABLE	NUT - DOUBLE HEX, HIGH TENSILE	EB PAGE 1 OF 2

ESNA ELASTIC STOP NUT CORPORATION OF AMERICA, UNION, NEW JERSEY.

②THREAD SQUARENESS: ESNA SPEC 405, GROUP 11, SIZES 1 4 THROUGH 1 2
ESNA SPEC 405, GROUP 1, SIZES 9 16 AND LARGER.

THREADS: MIL SPEC MIL-S-7742.

TOLERANCES: UNLESS OTHERWISE SPECIFIED: DECIMALS, ± .015

PERFORMANCE:
TORQUE: - NAS353 EXCEPT THAT THE ELEVATED TEMPERATURE TEST MAXIMUM IS 150°F.

AXIAL TENSILE STRENGTH - THE AXIAL TENSILE STRENGTH LISTED IN THE TABLE ON PAGE 1 OF 2 IS EQUIVALENT TO 180,000 PSI AT THE MINIMUM PITCH DIAMETER OF THE BOLT THREADS, FOR SIZES 1/4 THROUGH 1/2.

FOR SIZES 9/16 AND LARGER THE FIGURES LISTED ARE EQUIVALENT TO A MINIMUM OF 160,000 PSI AT THE MINIMUM PITCH DIAMETER OF THE BOLT THREADS.

APPROVAL STATUS: TYPE EB IS ACCEPTABLE FOR USE ON AIRCRAFT IN ACCORDANCE WITH BUREAU OF AERONAUTICS APPROVAL LETTERS 11472 AND 52353, DATED 15 FEB 49 AND 8 JUL 49, RESPECTIVELY, AND AIR MATERIEL COMMAND APPROVAL LETTER MCREXA71 DATA 20 JAN 50.

APPLICATION: TYPE EB IS DESIGNED FOR HIGH TENSILE APPLICATIONS WHERE WEIGHT AND SPACE LIMITATIONS ARE MAJOR CONSIDERATIONS.

ESNA AVAILABILITY CODE:
* - STANDARD PARTS NORMALLY CARRIED IN STOCK.
† - STANDARD PARTS IN STOCK OR AVAILABLE WITHIN NORMAL DELIVERY SCHEDULES.
Δ - STANDARD PARTS AVAILABLE WITHIN NORMAL DELIVERY SCHEDULES BUT FOR WHICH MINIMUM PRODUCTION RUN REQUIREMENTS ARE NECESSARY.
NT - PARTS WHICH CAN BE MADE AVAILABLE IN PROTOTYPE QUANTITIES BUT PROCUREMENT IN VOLUME SHOULD ALLOW FOR PRODUCTION TOOLING.

NOTES: 1. WHEN MEASURING ROCKWELL HARDNESS OF TYPE EB NUTS, IT IS NECESSARY TO CUT OFF THE ENTIRE LOCKING DEVICE, GRIND THE TOP OF THE NUT SMOOTH AND PARALLEL TO THE NUT SEATING SURFACE AND REMOVE THE CADMIUM PLATING FROM THE SEATING SURFACE. THE HARDNESS READING IS THEN TO BE TAKEN ON THE TOP OF THE NUT.

2. WITH THE EXCEPTION OF THE FOLLOWING SIZES, 9/16, 5/8, 3/4, 7/8, 1 AND 1 1/8, WHICH WILL ALWAYS BE MANUFACTURED AS FORGINGS, EB NUTS WILL BE MANUFACTURED AS EITHER FORGINGS OR FULLY MACHINED PARTS. REGARDLESS OF MANUFACTURING METHOD THESE PARTS ARE INTERCHANGEABLE BOTH WITH RESPECT TO ENVELOPE DIMENSIONS AND PERFORMANCE. THEY WILL BE SHIPPED INTERCHANGEABLY, DEPENDENT ONLY UPON CURRENT AVAILABILITY, UNLESS INSTRUCTIONS TO THE CONTRARY ARE RECEIVED FROM THE CUSTOMER.

③3. REFER TO ESNA STANDARD DRAWING NA101 FOR A TWO-LUG HIGH TENSILE NUT DESIGN.

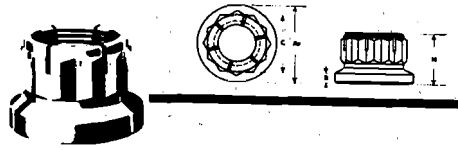
ISSUED: 5 JAN 51 REVISED: ②30 DEC 53 ③12 NOV 54

PERFORMANCE SPECIFICATION	ESNA - STANDARD	
NAS353 AS APPLICABLE	NUT - DOUBLE HEX, HIGH TENSILE	EB PAGE 2 OF 2

FLEXLOC® "DESIGNED for 550° F."

AIRCRAFT TYPE EXTERNAL WRENCHING LOCKNUT

SIZES: ¼" to ⅝"
STYLE "A"
National Fine Thread Series



STYLE A

FLEXLOC External Wrenching Nuts are extra-performance locknuts. Like standard FLEXLOCS, they are one-piece, all-metal; incorporate the same efficient, self-locking principle. Developed primarily for airframe assembly, they can be used to advantage in many other critical applications. High-strength A.M.S. 6280 minimum alloy steel makes possible extreme tensiles with minimum weight. 12-point serrations for standard box or socket wrenches facilitate installation, even in close clearances.

External Wrenching Nuts are also stop nuts, lock securely anywhere on a bolt or stud without seating. Closely controlled torques provide positive locking without thread galling. Repeated re-use and high temperatures (550° F. and over) do not impair locking efficiency. Approved under latest NAS Specifications, also tentative approvals under new MIL Specifications.

STYLE A

EXTERNAL WRENCHING NUT—¼ TO ⅝ INCH

NATIONAL FINE THREAD (S.A.E.) — **STEEL, PLATED**

SIZE Dia.	SIZE Thds. Per In.	CLASS FIT	PART NUMBER FLEXLOC NUT; Cad. Plated	DIMENSIONS A	DIMENSIONS H	DIMENSIONS C	DIMENSIONS B	MATERIAL	TENSILE VALUES FLEXLOC Approx.	TENSILE VALUES N.A.S. Standard ★	PACKING Qty. Per Carton	PACKING Wgt. Per 1000 Nuts
¼	28	3	42FW-428	.531	.344	.375	.090	Steel—Minimum A. M. S. 6280	5950	5700	100	10.
5/16	24	3	42FW-524	.593	.406	.437	.090		9610	9350	100	14.
⅜	24	3	42FW-624	.687	.453	.500	.099		14750	14500	100	20.
7/16	20	3	42FW-720	.781	.516	.562	.107		19800	19500	100	28.
½	20	3	42FW-820	.875	.563	.625	.133		27100	26700	100	36.
9/16	18	3	42FW-918	.968	.625	.687	.142		34500	34000	50	47.
⅝	18	3	42FW-1018	1.062	.672	.781	.151		43800	43300	50	65.

● These Parts are approved by both the Air Force and Bureau of Aeronautics for aircraft use.
★ Present National Aircraft Standard

WHEN ORDERING—BE SURE TO SPECIFY QUANTITY • FLEXLOC PART NUMBER • THREAD SIZE

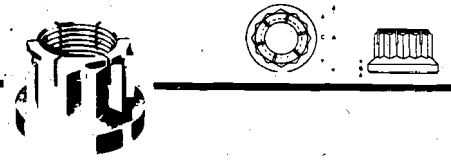
sps AIRCRAFT PRODUCTS DIVISION

EXTERNAL WRENCHING LOCKNUT

AIRCRAFT TYPE

SIZES: ¾" to 1½"
STYLE "B"
National Fine Thread Series

FLEXLOC® "DESIGNED for 550° F."



STYLE B

Style "B" FLEXLOC External Wrenching Locknuts shown on this page differ slightly in appearance from Style "A," illustrated on the preceding page. Differences are due solely to the manufacturing processes involved and in no way affect performance or other characteristics of the locknut.

Both styles are approved for aircraft use under latest NAS specifications, and have tentative approval under the new MIL Specification.

STYLE B

EXTERNAL WRENCHING NUT—¾ TO 1½ INCH

NATIONAL FINE THREAD (S.A.E.) — **STEEL, PLATED**

SIZE Dia.	SIZE Thds. Per In.	CLASS FIT	PART NUMBER FLEXLOC Part No.; Cad. Plated	DIMENSIONS A	DIMENSIONS H	DIMENSIONS C	DIMENSIONS B	MATERIAL	TENSILE VALUES FLEXLOC Approx.	TENSILE VALUES N.A.S. Standard ★	PACKING Qty. Per Carton	PACKING Wgt. Per 1000 Nuts
¾	16	3	42FW-1216	1.250	.781	.937	.185	Steel—Minimum A. M. S. 6280	64100	63400	50	110.
⅞	14	3	42FW-1414	1.437	.953	1.062	.219		87600	86900	25	169.
1	14	3	42FW-1614	1.625	1.125	1.187	.266		117900	116900	25	246.
1⅛	12	3	42FW-1812	1.875	1.296	1.375	.305		148100	146800	25	411.
1¼	12	3	42FW-2012	2.125	1.375	1.500	.320		193700	185400	25	515.
1⅜	12	3	42FW-2212	2.312	1.500	1.625	.350		237600	228300	125	660.
1½	12	3	42FW-2412	2.500	1.625	1.812	.375		286300	275400	25	844.

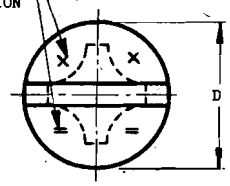
● These Parts are approved by both the Air Force and Bureau of Aeronautics for aircraft use.
★ Present National Aircraft Standard

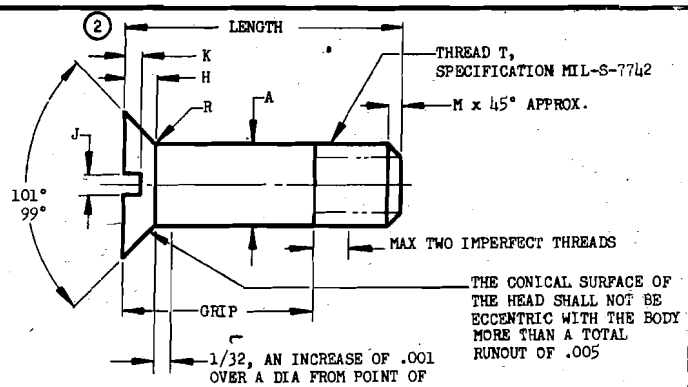
WHEN ORDERING—BE SURE TO SPECIFY QUANTITY • FLEXLOC PART NUMBER • THREAD SIZE

sps

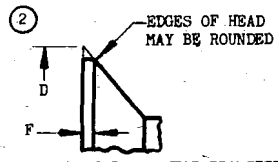
Sheet 619C-6

MARK STEEL SCREWS WITH "X", MARK BRONZE SCREWS WITH "=". ONLY ONE "X" OR "=" NEED BE VISIBLE AFTER SLOTTING. POSITION OPTIONAL



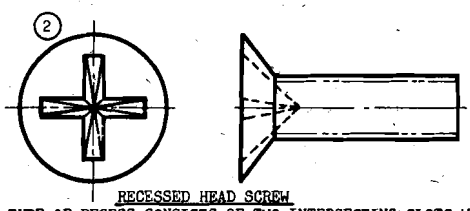


SLOTTED HEAD SCREW



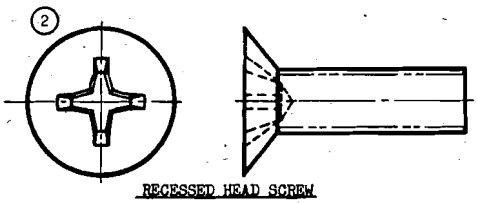
ENLARGED VIEW OF HEAD DIAMETER

THREAD T	A DIA		D DIA			F	(a) H REF	J		K		M	R RAD	
	MAX	MIN	MAX SHARP	MIN SHARP	ABSOLUTE MIN WITH MAX F	MAX		MAX	MIN	MAX	MIN	MAX	MAX	MIN
NO. 8-32 NC-3A	.1640	.1610	.332	.319	.283	.015	.068	.054	.045	.036	.027	.031	.015	.005
NO. 10-32 NF-3A	.1890	.1860	.385	.371	.327	.016	.080	.060	.050	.042	.031	.031	.015	.005
1/4 -28UNF-3A	.2490	.2460	.507	.491	.447	.018	.106	.075	.064	.055	.042	.031	.015	.005
5/16-24UNF-3A	.3115	.3085	.635	.617	.569	.020	.133	.084	.072	.069	.053	.047	.020	.010
3/8 -24UNF-3A	.3740	.3710	.762	.742	.686	.023	.159	.094	.081	.083	.064	.047	.020	.010
7/16-20UNF-3A	.4365	.4325	.890	.868	.805	.026	.186	.098	.082	.097	.077	.047	.020	.010
1/2 -20UNF-3A	.4990	.4950	1.017	.992	.919	.030	.213	.110	.094	.112	.088	.047	.020	.010
9/16-18UNF-3A	.5615	.5575	1.145	1.118	1.036	.034	.240	.122	.106	.127	.103	.047	.020	.010



RECESSED HEAD SCREW

THIS TYPE OF RECESS CONSISTS OF TWO INTERSECTING SLOTS WITH PARALLEL SIDES CONVERGING TO A SHARP APEX AT BOTTOM OF RECESS



RECESSED HEAD SCREW

THIS TYPE OF RECESS HAS A LARGE CENTER OPENING, TAPERED WINGS, AND BLUNT BOTTOM, WITH ALL EDGES RELIEVED OR ROUNDED

DIMENSIONING AND GAGING OF THE ABOVE TYPES OF RECESSES SHALL BE IN ACCORDANCE WITH THE 1950 SUPPLEMENT TO HANDBOOK H-28 SCREW THREADS FOR FEDERAL SERVICES 1944.

(2) (a) REFERENCE DIMENSIONS ARE FOR DESIGN PURPOSES ONLY AND ARE NOT AN INSPECTION REQUIREMENT.
(b) TOLERANCE ON THE LENGTHS FOR NO. 8-32, NO. 10-32, 1/4-28, AND 3/8-24 SCREWS = +1/32, -1/64; FOR 5/16-24 AND 9/16-18 SCREWS = +3/64, -0; FOR 7/16-20 AND 1/2-20 SCREWS = +1/64, -1/32.
(2) (c) BRONZE SCREWS INACTIVE FOR DESIGN AFTER 31 JANUARY 1952.

(2) FOR DEFINITION AND APPLICATION OF DRAWING STATUS NOTES, SEE ANA BULLETIN NO. 337.

(2) MATERIAL: STEEL, ALUMINUM ALLOY, SEE PROCUREMENT SPECIFICATION; COMMERCIAL BRONZE, 85,000 PSI MINIMUM.

(2) HEAT TREAT: LOW ALLOY STEEL, 125,000 TO 145,000 PSI TENSILE STRENGTH, SPECIFICATION MIL-H-6875; ALUMINUM ALLOY, 62,000 PSI TENSILE STRENGTH (MIN), SPECIFICATION MIL-H-6088.

(2) FINISH: STEEL OR ALUMINUM ALLOY, SEE PROCUREMENT SPECIFICATION; BRONZE, CADMIUM PLATE, SPECIFICATION QQ-P-416, TYPE I, CLASS C.

GRIP LENGTHS IN ADDITION TO THOSE TABULATED ARE AVAILABLE IN 1/8 INCH INCREMENTS BY THE USE OF SIGNIFICANT DASH NUMBERS.

PLAIN DASH NUMBERS INDICATE STEEL SCREWS.

(2) (c) ~~ADD C BEFORE FIRST DASH NUMBER FOR BARE BRONZE SCREWS. ADD P BEFORE FIRST DASH NUMBER FOR PLATED BRONZE SCREWS.~~
ADD C BEFORE FIRST DASH NUMBER FOR CORROSION RESISTANT STEEL SCREWS.
ADD D BEFORE FIRST DASH NUMBER FOR ALUMINUM ALLOY SCREWS.
ADD R BETWEEN FIRST AND SECOND DASH NUMBER FOR RECESSED HEAD SCREWS.

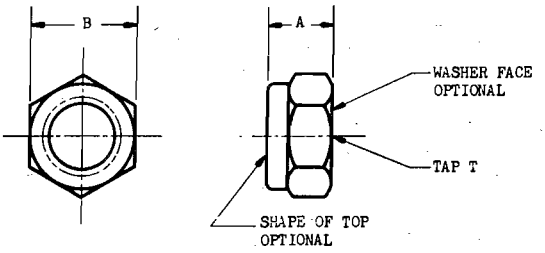
EXAMPLES OF PART NOS.: AN509-10-12 = NO. 10 SLOTTED HEAD STEEL SCREW 25/32 INCH LONG.
(2) ~~(c) AN509P10-12 = NO. 10 SLOTTED HEAD PLATED BRONZE SCREW 25/32 INCH LONG.~~
(2) ~~(c) AN509B10-12 = NO. 10 SLOTTED HEAD BARE BRONZE SCREW 25/32 INCH LONG.~~
AN509C10-12 = NO. 10 SLOTTED HEAD CORROSION RESISTANT STEEL SCREW 25/32 INCH LONG.
AN509DD10-12 = NO. 10 SLOTTED HEAD ALUMINUM ALLOY SCREW 25/32 INCH LONG.
AN509-10R12 = NO. 10 RECESSED HEAD STEEL SCREW 25/32 INCH LONG.

(2) SCREWS SHALL BE FREE OF ALL LOOSE OR HANGING BURRS OR SLIVERS WHICH MIGHT BECOME DISLODGED UNDER USAGE.

DIMENSIONS IN INCHES.

APPROVED 21 May 45 REVISED (1) 22 Jul 47 (2) 31 Jan 52

(2) PROCUREMENT SPECIFICATION	AIR FORCE-NAVY AERONAUTICAL STANDARD	AN509
MIL-S-7839	(2) SCREW - MACHINE, FLAT HEAD, 100°, STRUCTURAL	SHEET 1 OF 3



FINE THREAD

DASH NUMBERS			TAP T	(a) A +.016	B +.002 -.010
STEEL	(1) COPPER BASE ALLOY	AL ALLOY			
448			NO. 4-48 NF-2	.141	.250
(b) 640	B640	D640	NO. 6-40 NF-2	.172	.312
836	B836	D836	NO. 8-36 NF-2	.234	.344
1032	B1032	D1032	NO. 10-32 NF-3	.234	.375
428	B428	D428	1/4 -28 NF-3	.312	.438
524	B524	D524	5/16-24 NF-3	.344	.500
624	B624	D624	3/8 -24 NF-3	.453	.563
720	B720	D720	7/16-20 NF-3	.453	.625
820	B820	D820	1/2 -20 NF-3	.594	.750
918	B918	D918	9/16-18 NF-3	.688	.875
1018	B1018	D1018	5/8 -18 NF-3	.750	.938
1216	B1216	D1216	3/4 -16 NF-3	.875	1.063
1414	B1414	D1414	7/8 -14 NF-3	1.000	1.250
1614	B1614	D1614	1 -14 NF-3	1.125	1.438
1812	B1812	D1812	1-1/8 -12 NF-3	1.250	1.625
2012	B2012	D2012	1-1/4 -12 NF-3	1.438	1.813

COARSE THREAD

440	B440	D440	NO. 4-40 NC-2	.141	.250
632	B632	D632	NO. 6-32 NC-2	.172	.312
832	B832	D832	NO. 8-32 NC-2	.234	.344
1024	B1024	D1024	NO. 10-24 NC-3	.234	.375
420	B420	D420	1/4 -20 NC-3	.312	.438
518	B518	D518	5/16-18 NC-3	.344	.500
616	B616	D616	3/8 -16 NC-3	.453	.563
714			7/16-14 NC-3	.453	.625
(b) 813	B813		1/2 -13 NC-3	.594	.750
912	B912	D912	9/16-12 NC-3	.688	.875
1011	B1011	D1011	5/8 -11 NC-3	.750	.938
1210	B1210	D1210	3/4 -10 NC-3	.875	1.063
1409	B1409	D1409	7/8 - 9 NC-3	1.000	1.250
1608	B1608	D1608	1 - 8 N-3	1.125	1.438
1808	B1808	D1808	1-1/8 - 8 N-3	1.250	1.625
2008	B2008	D2008	1-1/4 - 8 N-3	1.438	1.813

(a) MINIMUM A NOT SPECIFIED. LIMITED ONLY BY STRENGTH REQUIREMENT OF SPECIFICATION.

(1) (b) DASH NUMBERS 448 THRU 836 AND B640 THRU B836 AND D640 THRU D836 FOR FINE THREAD NUTS AND 1024 THRU 2008 AND B1024 THRU B2008 AND D1024 THRU D2008 FOR COARSE THREAD NUTS INACTIVE FOR DESIGN AFTER 14 APRIL, 1949.

(1) FOR DEFINITION AND APPLICATION OF DRAWING STATUS NOTE SEE ANA BULLETIN NO. 337.

(1) ADD A AFTER DASH NUMBER FOR NUTS HAVING NON-METALLIC INSERTS.

(1) ADD C AFTER DASH NUMBER FOR NUTS FABRICATED ENTIRELY FROM METAL.

(1) EXAMPLES OF PART NUMBERS: AN365-428 = 1/4-28 STEEL NUT, EITHER ALL METAL OR WITH NON-METALLIC INSERT.
AN365D428 = 1/4-28 ALUMINUM ALLOY NUT, EITHER ALL METAL OR WITH NON-METALLIC INSERT.
AN365B428A = 1/4-28 COPPER BASE ALLOY NUT WITH NON-METALLIC INSERT.
AN365-428C = 1/4-28 STEEL ALL METAL NUT.

DIMENSIONS IN INCHES.

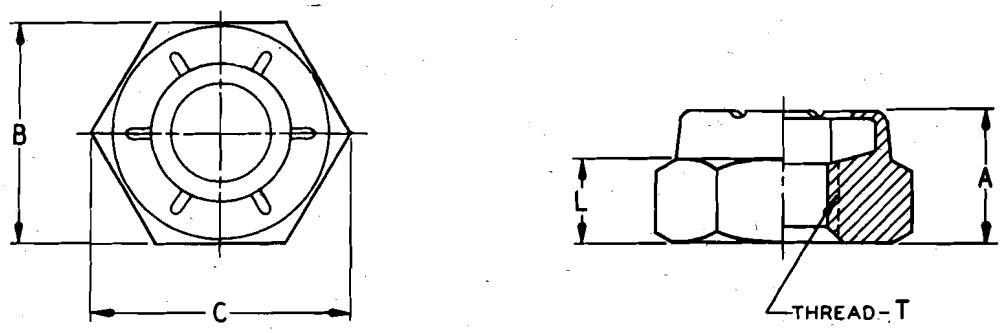
FOR INSTALLATION INSTRUCTIONS SEE DRAWING AND10068.

APPROVED 21 Aug 45 REVISED (1) 14 Apr 49

PROCUREMENT SPECIFICATION	AIR FORCE-NAVY AERONAUTICAL STANDARD	
AN-N-5	(1) NUT-SELF LOCKING, 250° F	AN365

SUPERSEDES USAF DRAWING 365 AND NAF DRAWING 1137

GPO 821594
WADC TR 57-330



ESNA PART NUMBER	THREAD T	A	B	C MIN	L REF
MJ-40	4-40NC-3B	.143 $^{\pm.010}$	.252 - .240	.275	.081
MJ-62	6-32NC-3B	.178 $^{\pm.010}$	.314 - .302	.344	.103
MJ-82	8-32NC-3B	.266	.346 - .334	.378	.170
MJ-02	10-32NF-3	.266	.377 - .365	.413	.170
MJ-048	1/4-28NF-3	.345	.440 - .428	.488	.257

CODE: PART NUMBER AS LISTED IN THE TABULATION ABOVE DESIGNATES HIGH STRENGTH ALUMINUM ALLOY HEX NUT WITH FIBRE LOCKING INSERT.
PREFIX LETTER "N" TO PART NUMBER LISTED IN THE TABULATION ABOVE DESIGNATES HIGH STRENGTH ALUMINUM ALLOY HEX NUT WITH NYLON LOCKING INSERT.

EXAMPLE: MJ-02 = FIBRE LOCKING INSERT, HIGH STRENGTH ALUMINUM ALLOY HEX NUT, TYPE MJ, 10-32 THREAD.
NMJ-02 = NYLON LOCKING INSERT, HIGH STRENGTH ALUMINUM ALLOY HEX NUT, TYPE MJ, 10-32 THREAD.

① MATERIAL: ALUMINUM ALLOY, 2014-T6 (AMS 4121).
ALUMINUM ALLOY, 2024-T4 (AMS 4037) 1/4 SIZE ONLY.

① FINISH: ANODIZE, MIL SPEC MIL-A-8625(ASG) DYED BLUE AND LUBRICATED.

① LOCKING INSERT: RED FIBER
RED NYLON, "ZYTEL" 101.

THREAD SQUARENESS: ESNA SPEC 405, GROUP 1.

THREADS: MIL SPEC MIL-S-7742.

TOLERANCES: UNLESS OTHERWISE SPECIFIED: DECIMALS, ± .015

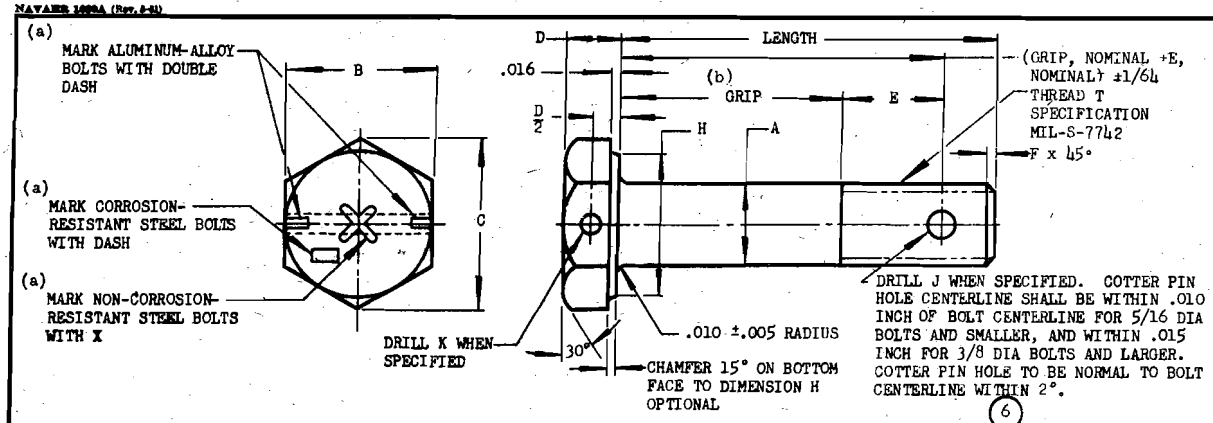
PERFORMANCE: ESNA SPEC 414.

APPROVAL STATUS: PENDING QUALIFICATION UNDER APPLICABLE MS STANDARD DRAWINGS BEING COORDINATED BY THE SERVICES AND INDUSTRY, APPROVAL FOR AIRCRAFT USE OF TYPE MJ NUTS AT STEEL LOADS MAY BE OBTAINED FROM EITHER THE BUREAU OF AERONAUTICS, FOR BUAER CONTRACTS, OR THE AIR MATERIEL COMMAND, FOR AIR FORCE CONTRACTS.

APPLICATION: TYPE MJ HIGH STRENGTH ALUMINUM ALLOY NUTS ARE DESIGNED TO BE USED IN PLACE OF STEEL NUTS ON 125,000 PSI STEEL SCREWS IN ORDER TO EFFECT AN APPRECIABLE WEIGHT SAVING. (SEE NOTE 1).

ISSUED: 13 APR 54 REVISED ① 5 JAN 56

PERFORMANCE SPECIFICATION	ESNA - STANDARD	MJ
ESNA SPEC 414	NUT - HEX, MACHINE SCREW, HIGH STRENGTH ALUMINUM ALLOY	PAGE 1 OF 2



BASIC AN PART NO.	THREAD T	A DIA MAX	A DIA MIN	B MAX	B MIN	C REF	D MAX	D MIN	E REF	F MAX	F MIN	(c) H DIA MIN	J DRILL DIA +.010 -.000	K DRILL DIA +.010 -.000
AN3	NO. 10-32 NF-3A	.189	.186	.377	.365	.430	.141	.109	17/64	.047	.015	.359	.070	.046
AN4	1/4 -28 UNF-3A	.249	.246	.440	.428	.510	.172	.140	5/16	.047	.015	.422	.076	.046
AN5	5/16-24 UNF-3A	.312	.309	.502	.490	.580	.204	.172	23/64	.063	.021	.484	.076	.070
AN6	3/8 -24 UNF-3A	.374	.371	.565	.553	.650	.235	.203	7/16	.063	.031	.547	.106	.070
AN7	7/16-20 UNF-3A	.437	.433	.627	.615	.720	.266	.234	31/64	.063	.031	.609	.106	.070
AN8	1/2 -20 UNF-3A	.499	.495	.752	.740	.870	.297	.265	39/64	.063	.031	.734	.106	.070
AN9	9/16-18 UNF-3A	.562	.558	.877	.865	1.010	.328	.296	21/32	.078	.046	.859	.141	.070
AN10	5/8 -18 UNF-3A	.624	.620	.940	.928	1.090	.360	.328	47/64	.078	.046	.922	.141	.070
AN12	3/4 -16 UNF-3A	.749	.744	1.066	1.053	1.230	.422	.390	7/8	.078	.046	1.047	.141	.070
AN14	7/8 -14 UNF-3A	.874	.869	1.253	1.240	1.440	.485	.453	63/64	.094	.062	1.234	.141	.070
AN16	1 -14 NF-3A	.999	.993	1.441	1.428	1.660	.547	.515	1-3/32	.094	.062	1.422	.141	.070
AN18	1-1/8 -12 UNF-3A	1.124	1.118	1.628	1.615	1.880	.610	.578	1-3/16	.110	.078	1.609	.141	.070
AN20	1-1/4 -12 UNF-3A	1.249	1.243	1.815	1.802	2.090	.672	.640	1-3/8	.110	.078	1.796	.141	.070

6 SEE SHEET 3 FOR NOTES (a) AND (b).

6 (c) THE DIAMETER OF THE WASHER FACE SHALL NOT EXCEED THE ACTUAL WIDTH ACROSS FLATS.

MATERIAL: NON-CORROSION-RESISTANT STEEL, CORROSION-RESISTANT STEEL OR ALUMINUM ALLOY. SEE PROCUREMENT SPECIFICATION.

FINISH: SEE PROCUREMENT SPECIFICATION.

ADD C BEFORE DASH NUMBER FOR CORROSION-RESISTANT STEEL BOLT.
ADD DD BEFORE DASH NUMBER FOR ALUMINUM-ALLOY BOLT.
ADD A AFTER DASH NUMBER FOR UNDRILLED BOLT. SEE ILLUSTRATION.
ADD H BEFORE DASH NUMBER FOR BOLT WITH DRILLED HEAD AND SHANK. SEE ILLUSTRATION.
ADD H BEFORE DASH NUMBER AND A AFTER DASH NUMBER FOR BOLT WITH DRILLED HEAD ONLY. SEE ILLUSTRATION.

EXAMPLES OF PART NUMBERS:

AN6-10 = 3/8 NON-CORROSION-RESISTANT STEEL BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED SHANK ONLY. SEE ILLUSTRATION.
AN6C10 = 3/8 CORROSION-RESISTANT STEEL BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED SHANK ONLY. SEE ILLUSTRATION.
AN6DD10 = 3/8 ALUMINUM-ALLOY BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED SHANK ONLY. SEE ILLUSTRATION.
AN6DD10A = 3/8 ALUMINUM-ALLOY BOLT 1-5/64 LONG, 7/16 GRIP, UNDRILLED SHANK AND HEAD. SEE ILLUSTRATION.
AN6DDH10 = 3/8 ALUMINUM-ALLOY BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED HEAD AND SHANK. SEE ILLUSTRATION.
AN6DDH10A = 3/8 ALUMINUM-ALLOY BOLT 1-5/64 LONG, 7/16 GRIP WITH DRILLED HEAD ONLY. SEE ILLUSTRATION.

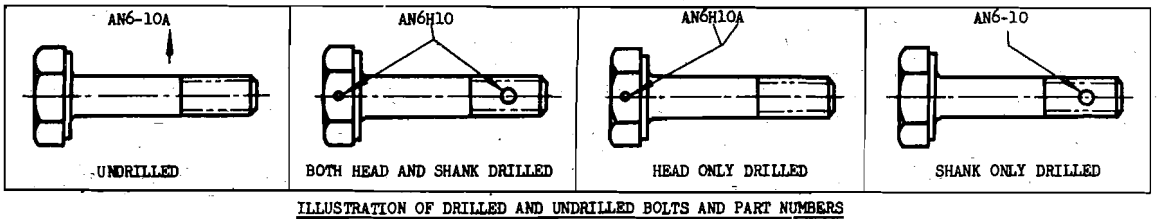


ILLUSTRATION OF DRILLED AND UNDRILLED BOLTS AND PART NUMBERS

6 BOLTS SHALL BE FREE FROM ALL HANGING BURRS AND SLIVERS WHICH MIGHT BECOME DISLODGED UNDER USAGE. COUNTERSINKING OF DRILLED HOLES IN HEAD IS MANDATORY. COUNTERSINKING OF DRILLED HOLES IN SHANK IS OPTIONAL.

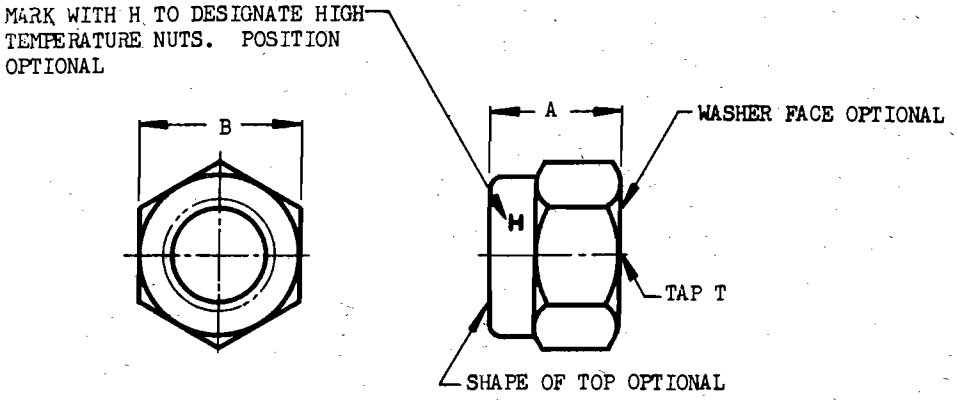
DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: DECIMALS ±.010, ANGLES ±5°.

APPROVED 10 May 43 REVISED (4) 20 Jan 49 (5) 24 Mar 52 (6) 15 Mar 55

PROCUREMENT SPECIFICATION	AIR FORCE-NAVY AERONAUTICAL STANDARD	AN3 THRU AN20
MIL-B-6812	BOLT - MACHINE, AIRCRAFT	SHEET 1 OF 4

SUPERSEDES FORMER ANA STANDARD AND AIR FORCE AND NAVY STANDARD ISSUES OF AN3 THROUGH AN20.

GPO 821257
WADC TR 57-330



FINE THREAD

DASH NUMBERS			TAP T	(a) (2) A +.016	(2) B +.002 -.010
COR RES STEEL	STEEL	COPPER BASE ALLOY			
C1032	1032	B1032	NO. 10-32 NF-3	.234	.375
C428	428	B428	1/4 -28 NF-3	.312	.438
C524	524	B524	5/16-24 NF-3	.344	.500
C624	624	B624	3/8 -24 NF-3	.453	.563
C720	720	B720	7/16-20 NF-3	.453	.625
C820	820	B820	1/2 -20 NF-3	.594	.750
C918	918	B918	9/16-18 NF-3	.688	.875
C1018	1018	B1018	5/8 -18 NF-3	.750	.938
C1216	1216	B1216	3/4 -16 NF-3	.875	1.063

(2) COARSE THREAD

C632	632	B632	No. 6-32 NC-2	.172	.312
C832	832	B832	No. 8-32 NC-2	.234	.344
C1024	1024	B1024	No. 10-24 NC-2	.234	.375
C420	420	B420	1/4 -20 NC-3	.312	.438
C518	518	B518	5/16-18 NC-3	.344	.500
C616	616	B616	3/8 -16 NC-3	.453	.563
C714	714	B714	7/16-14 NC-3	.453	.625
C813	813	B813	1/2 -13 NC-3	.594	.750
C913	913	B913	9/16-12 NC-3	.688	.875
C1011	1011	B1011	5/8 -11 NC-3	.750	.938
C1210	1210	B1210	3/4 -10 NC-3	.875	1.063

(2) (b)

(a) MINIMUM A NOT SPECIFIED. LIMITED ONLY BY STRENGTH REQUIREMENT OF SPECIFICATION.

(b) DASH NOS. C1024 THRU C1210, 1024 THRU 1210, AND B1024 THRU B1210 FOR COARSE THREAD NUTS INACTIVE FOR DESIGN AFTER 14 APRIL 1949.

(2) FOR DEFINITION AND APPLICATION OF DRAWING STATUS NOTE SEE ANA BULLETIN NO. 337.

(2) EXAMPLES OF PART NUMBERS: AN363-428 = 1/4-28 STEEL NUT.
AN363B632 = NO. 6-32 COPPER BASE ALLOY NUT.
AN363C428 = 1/4-28 CORROSION RESISTING STEEL NUT.

(2) DIMENSIONS IN INCHES.

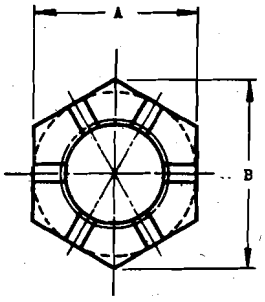
FOR INSTALLATION INSTRUCTIONS SEE DRAWING AND10068.

APPROVED 13 Jul 45 REVISED (1) 27 Sep 45 (2) 14 Apr 49

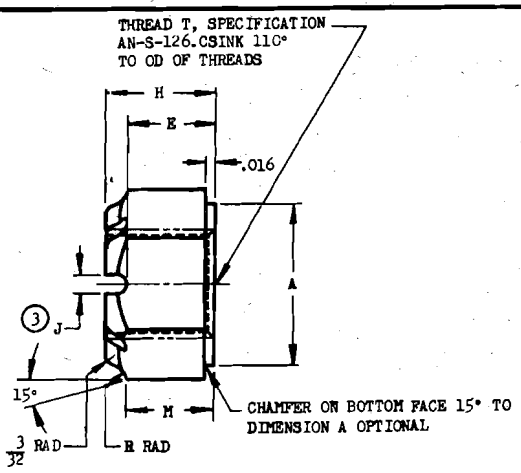
PROCUREMENT SPECIFICATION	AIR FORCE-NAVY AERONAUTICAL STANDARD	AN363
AN-N-10	(2) NUT - SELF LOCKING, 550°F	

SUPERSEDES USAF DRAWING 363

3PO 813495



ROUND OR SQUARE BOTTOM CASTELLATION OPTIONAL



③

AN PART NO.	THREAD T	ULTIMATE TENSILE STRENGTH MINIMUM, POUNDS		(a) A	B APPROX	③ E	H	J +1/32 -0	M	R
		STEEL	AL ALLOY							
AN310- 3	NO. 10-32NF-3	2 210	1 100	$.375^{+.002}_{-.010}$	7/16	7/64	1/4	5/64	.110	3/32
AN310- 4	1/4 -28NF-3	4 080	2 030	$.438^{+.002}_{-.010}$	1/2	1/8	9/32	5/64	.125	3/32
AN310- 5	5/16-24NF-3	6 500	3 220	$.500^{+.002}_{-.010}$	37/64	11/64	21/64	5/64	.172	3/32
AN310- 6	3/8 -24NF-3	10 100	5 020	$.563^{+.002}_{-.010}$	21/32	7/32	13/32	1/8	.218	3/32
AN310- 7	7/16-20NF-3	13 600	6 750	$.625^{+.002}_{-.011}$	23/32	17/64	29/64	1/8	.265	3/32
AN310- 8	1/2 -20NF-3	18 500	9 180	$.750^{+.002}_{-.012}$	7/8	23/64	9/16	1/8	.359	1/8
AN310- 9	9/16-18NF-3	23 600	11 700	$.875^{+.002}_{-.012}$	1- 1/64	25/64	39/64	5/32	.390	5/32
AN310-10	5/8 -18NF-3	30 100	14 900	$1.000^{+.002}_{-.014}$	1- 5/32	15/32	23/32	5/32	.468	5/32
AN310-12	3/4 -16NF-3	44 000	21 800	$1.125^{+.002}_{-.016}$	1-19/64	9/16	13/16	5/32	.562	3/16
AN310-14	7/8 -14NF-3	60 000	29 800	$1.313^{+.002}_{-.017}$	1-33/64	21/32	29/32	5/32	.656	3/16
AN310-16	1 -14NF-3	80 700	40 000	$1.500^{+.002}_{-.019}$	1-47/64	3/4	1	5/32	.750	3/16
AN310-18	1-1/8 -12NF-3	101 800	50 500	$1.688^{+.002}_{-.021}$	1-61/64	13/16	1- 5/32	5/32	.844	1/4
AN310-20	1-1/4 -12NF-3	130 200	64 400	$1.875^{+.002}_{-.023}$	2-11/64	7/8	1- 1/4	5/32	.938	1/4

(a) FOR AL ALLOY NUTS LARGER THAN -5 SIZE, TOLERANCES ON A MAY CONFORM TO APPLICABLE MATERIAL SPECIFICATIONS FOR BAR AND ROD.

MATERIAL: STEEL, AL ALLOY AND CORROSION RESISTING STEEL. SEE PROCUREMENT SPECIFICATION.

FINISH: SEE PROCUREMENT SPECIFICATION.

ADD D BEFORE DASH NUMBER FOR AL ALLOY NUTS.

ADD C BEFORE DASH NUMBER FOR CORROSION RESISTING STEEL NUTS.

EXAMPLES OF PART NOS.: AN310-5 = STEEL NUT, 5/16-24NF-3.
AN310D5 = AL ALLOY NUT, 5/16-24NF-3.
AN310C5 = CORROSION RESISTING STEEL NUT, 5/16-24NF-3.

③ REMOVE ALL BURRS.

DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: FRACTIONS ±1/64, DECIMALS ±.010, ANGLES ±1°

APPROVED 5 Jul 43 REVISED ① 4 Mar 44 ② 25 May 44 ⑤ 31 Mar 49

PROCUREMENT SPECIFICATION	AIR FORCE-NAVY AERONAUTICAL STANDARD	AN310
AN-N-2	③ NUT-CASTELLATED, AIRFRAME	

SUPERSEDES FORMER USAF AND NAVY STANDARD ISSUES OF AN310

GPO 821597
WADC TR 57-330

APPENDIX II

HARDNESS & SURFACE FINISH TEST DATA

DATA SHEET

COMPARISON OF HARDNESS & SURFACE FINISH OF NUTS SUPPLIED BY AIRCRAFT MANUFACTURERS WITH " " " ASCH EQUIPMENT CO.

DIA. SIZE	HARDNESS ROCKWELL "C"			BEARING SURFACE FINISH R.M.S.		
	EB NUTS ASCH EQUIP. CO.	42 FW BOEING AIRPLANE CO.	42 FW LOCKHEED AIRCRAFT CO.	EB NUTS ASCH EQUIP. CO.	42 FW BOEING AIRPLANE CO.	42 FW LOCKHEED AIRCRAFT CO.
1/4	10	35	—	18.6	34.3	—
5/16	25	36	—	24.6	57.6	—
3/8	13	33	—	21.7	70.4	—
7/16	11	29	29	25.7	66	24.3
1/2	27	33	—	26.3	74.6	—
9/16	20	33	34	26.2	79.8	32.1
5/8	30	30	28	27.3	79.8	39.0
3/4	21	31	31	25.9	53.2	32.3
7/8	31	—	28	19.7	—	25.3
1"	32	31	35	22.6	52.5	72.2
1 1/8	39	35	—	25.7	60.6	—

DATA SHEET

SURFACE FINISH
SPACER BLOCKS

GROUND FINISH		SANDED FINISH		MACHINED C'SINK SURFACE	
SPACER	R.M.S.	SPACER	R.M.S.	SPACER	R.M.S.
37	10	9	24	16	85
	10		20		90
36	14	5	9	14	47
	11		15		50
35	5	1	19	12	NOT AVAILABLE
	5		12		
34	7	2B	14	10	50
	8		17		50
33	9	2Ac	13	12A	NOT AVAILABLE
	11		13		
32	13	1Bc	5	6	11
	9		7		16
31	10	1Ac	18	4	12
	10		18		20
30	6	1Ac	19	2	13
	7		17		20
29	5	2Ac	14	10A	70
	3		16		60
28	4	2Bc	16	8A	37
	5		16		28
TOTAL	162		302	2,4,6&8A 10,10A,14&16	(157) (502)
AVERAGE	8.1		15.1	SPEC. 2,4,6&8A 19.6	SPEC. 10,10A,14&16 62.8
(1) AVE. X 1.33	10.8		20.1	26.1	83.5

NOTE: (1) READING CORRECTED TO PROFILOMETER CALIBRATION.

—DATA SHEET—

HARDNESS & SURFACE FINISH

1. NUTS FURNISHED BY BOEING AIRPLANE CO. FOR COMPARISON
2. MFG. BY STD. PRESSED STEEL CO.

BOEING

NUT No.	SPEC.	HARDNESS - ROCKWELL "C"				SURFACE FINISH - RMS.			
		1ST. READING	2ND. READING	TOTAL	AVERAGE	1ST. READING	2ND. READING	AVERAGE	(1) AVE. x 1.33
42FW-918	1	28	34	62		47	50		
	2	37	34	71		75	80		
	3	30	33	63		60	48		
				196	33			60	79.8
42FW-1018	1	26	26	52		60	65		
	2	31	32	63		45	55		
	3	33	29	62		65	70		
				177	30			60	79.8
42FW-1216	1	28	32	60		27	35		
	2	30	28	58		48	52		
	3	33	36	69		38	40		
				187	31			40	53.2
42FW-1614	1	28	33	61		32	35		
	2	36	33	69		50	45		
	3	26	32	58		35	40		
				188	31			39.5	52.5
42FW-1812	1	32	33	65		40	47		
	2	36	33	69		37	48		
	3	35	38	73		47	55		
				207	35			45.6	60.6

NOTE: (1) READING CORRECTED TO PROFILOMETER CALIBRATION.

—DATA SHEET—

HARDNESS & SURFACE FINISH

1. NUTS FURNISHED BY LOCKHEED AIRCRAFT CORP. FOR COMPARISON.
2. MFG. BY STD. PRESSED STEEL CO.

LOCKHEED

NUT NO.	SPEC.	HARDNESS - ROCKWELL "C"				SURFACE FINISH - RMS.			
		1ST READING	2ND READING	TOTAL	AVERAGE	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
42FW-918	1	36	36	72		22	23		
	2	35	34	69		25	20		
	3	28	34	62		25	30		
				203	34			24.1	32.1
42FW-1018	1	25	28	53		23	30		
	2	31	32	63		30	25		
	3	26	28	54		32	36		
				170	28			29.3	39.0
42FW-1216	1	29	31	60		20	22		
	2	30	29	59		30	24		
	3	32	37	69		25	25		
				188	31			24.3	32.3
42FW-1414	1	31	27	58		20	22		
	2	24	24	48		23	19		
	3	30	30	60		15	15		
				166	28			19	25.3
42FW-1614	1	27	31	58		40	37		
	2	41	38	79		65	72		
	3	34	38	72		57	55		
				209	35			54.3	72.2

NOTE: (1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

1. NUTS FURNISHED BY LOCKHEED AIRCRAFT CORP. & BOEING AIRPLANE CO. FOR COMPARISON.
2. MFG. BY STD. PRESSED STEEL CO.

NUT No.	SPEC.	HARDNESS - ROCKWELL "C"				SURFACE FINISH - RMS.			
		1ST READING	2ND READING	TOTAL	AVERAGE	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
42FW-720 LOCKHEED	1	32	24	56		22	14		
	2	28	32	60		22	17		
	3	31	29	60		15	20		
				176	29			18.3	24.3
42FW-428 BOEING	1	33	33	66		21	23		
	2	37	38	75		22	32		
	3	36	34	70		30	27		
				211	35			25.8	34.3
42FW-524 BOEING	1	34	31	65		55	43		
	2	36	38	74		40	40		
	3	38	37	75		37	45		
				214	36			43.3	57.6
42FW-624 BOEING	1	34	32	66		55	52		
	2	33	29	62		70	65		
	3	34	34	68		40	35		
				196	33			52.9	70.4
42FW-720 BOEING	1	35	28	63		35	42		
	2	31	32	63		57	70		
	3	23	22	45		52	42		
				171	29			49.6	66
42FW-820 BOEING	1	33	35	68		35	40		
	2	32	28	60		70	67		
	3	35	32	67		60	65		
				195	33			56.1	74.6

NOTE: (1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: A NUT Nº: EB-048

AN STD. Nº: MS 20004-42 SPACER Nº: (2)-1BC

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	37	38	75	
	2	42	41	83	
	3	41	38	79	
				237	40
NUT	1	12	14	26	
	2	6	8	14	
	3	9	10	19	
				59	10
SPACER	1-BC	65	65	130	65
SPACER	1-BC	64	64	128	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	8	14		
	2	7	13		
	3	8	7		
				9.5	12.6
NUT	1	11	14		
	2	13	15		
	3	17	14		
				14	18.6
SPACER	1-BC	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	1-BC	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: B NUT Nº: EB-054

AN STD. Nº: MS 20005-50 SPACER Nº: (2)- 2Ac

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	42	44	86	
	2	22	22	44	
	3	39	39	78	
				208	35
NUT	1	20	26	46	
	2	26	26	52	
	3	27	26	53	
				151	25
SPACER	2-Ac	65	65	130	65
SPACER	2-Ac	64	65	129	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	11	14		
	2	13	13		
	3	11	11		
				12.1	16.1
NUT	1	16	21		
	2	15	16		
	3	22	21		
				18.5	24.6
SPACER	2-Ac	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2-Ac	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº C NUT Nº EB-064

AN STD. Nº MS 20006-50 SPACER Nº 2-Bc & 2-B

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	36	41	77	
	2	34	34	68	
	3	31	31	62	
				207	35
NUT	1	12	15	27	
	2	17	15	32	
	3	10	11	21	
				80	13
SPACER	2-Bc	64	65	129	65
SPACER	2-B	65	65	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	19	17		
	2	18	16		
	3	13	13		
				16	21.3
NUT	1	19	15		
	2	15	16		
	3	14	19		
				16.3	21.7
SPACER	2-Bc	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2-B	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº. D

NUT Nº. EB-070

AN STD. Nº. MS 20007-50

SPACER Nº. 2-Cc & 2-C

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	38	37	75	
	2	41	30	71	
	3	40	41	81	
				227	38
NUT	1	7	9	16	
	2	10	14	24	
	3	11	13	24	
				64	11
SPACER	2-C	63	64	127	64
SPACER	2-Cc	64	65	129	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	14	12		
	2	18	17		
	3	21	17		
				16.5	21.9
NUT	1	17	15		
	2	18	22		
	3	24	20		
				19.3	25.7
SPACER	2-C	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2-Cc	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: E

NUT Nº: EB-080

AN STD. Nº: MS 20008-50

SPACER Nº: 2-Dc & 2-D

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	43	44	87	
	2	44	44	88	
	3	43	44	87	
				262	44
NUT	1	21	24	45	
	2	27	32	59	
	3	29	30	59	
				163	27
SPACER	2-Dc	64	64	128	64
SPACER	2-D	63	63	126	63

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	15	18		
	2	14	23		
	3	21	16		
				17.8	23.7
NUT	1	18	23		
	2	15	20		
	3	18	25		
				19.8	26.3
SPACER	2-Dc	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2-D	(1) AVERAGE R.M.S. 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: F NUT Nº: EB-098

AN STD. Nº: MS 20009-50 SPACER Nº: 17 & 18

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	36	35	71	
	2	42	41	83	
	3	37	39	76	
				230	38
NUT	1	18	21	39	
	2	31	30	61	
	3	8	10	18	
				118	20
SPACER	17	54	57	111	56
SPACER	18	54	61	115	58

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	16	16		
	2	13	20		
	3	19	22		
				17.5	23.3
NUT	1	19	16		
	2	26	26		
	3	15	16		
				19.7	26.2
SPACER	17	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	18	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: G NUT Nº: EB-108

AN STD. Nº: MS 20010-50 SPACER Nº: 20 & 21

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	38	39	77	
	2	39	40	79	
	3	39	40	79	
				235	39
NUT	1	34	28	62	
	2	30	30	60	
	3	29	30	59	
				181	30
SPACER	20	57	55	112	56
SPACER	21	57	60	117	58.5

SURFACE FINISH (R.M.S.)

ITEM	SPEC Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	26	15		
	2	20	30		
	3	24	19		
				22.3	29.7
NUT	1	21	23		
	2	23	21		
	3	16	19		
				20.5	27.3
SPACER	20	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	21	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº. H NUT Nº. EB-126

AN STD. Nº. MS 20012-50 SPACER Nº. 22 & 24

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	45	45	90	
	2	41	42	83	
	3	44	45	89	
				262	44
NUT	1	31	26	57	
	2	18	19	37	
	3	16	17	33	
				127	21
SPACER	22	61	57	118	59
SPACER	24	59	55	114	57

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	12	12		
	2	11	13		
	3	15	14		
				12.8	17
NUT	1	22	25		
	2	17	16		
	3	16	21		
				19.5	25.9
SPACER	22	(1) AVERAGE R.M.S. -20.1 SEE PAGE			
SPACER	24	(1) AVERAGE R.M.S. -20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: I NUT Nº: EB-144

AN STD. Nº: MS 20014-50 SPACER Nº: 25 & 27

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	40	41	81	
	2	42	43	85	
	3	41	43	84	
				250	42
NUT	1	37	38	75	
	2	24	30	54	
	3	23	32	55	
				184	31
SPACER	25	60	59	119	60
SPACER	27	56	56	112	56

SURFACE FINISH (R.M.S.)

ITEM	SPEC Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	18	13		
	2	17	13		
	3	15	16		
				15.3	20.3
NUT	1	14	13		
	2	17	16		
	3	16	13		
				14.8	19.7
SPACER	25	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	27	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: J NUT Nº: EB-164

AN STD. Nº: MS 20016-50 SPACER Nº: 28 & 29

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	42	42	84	
	2	41	41	82	
	3	43	42	85	
				251	42
NUT	1	29	33	61	
	2	33	33	66	
	3	35	32	67	
				194	32
SPACER	28	67	67	134	67
SPACER	29	56	57	113	57

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	27	30		
	2	30	25		
	3	32	33		
				29.5	39.2
NUT	1	13	19		
	2	17	15		
	3	19	19		
				17	22.6
SPACER	28	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	29	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: K NUT Nº: EB-182

AN STD. Nº: MS 20018-50 SPACER Nº: 30 & 31

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	42	44	86	
	2	42	43	85	
	3	43	43	86	
				257	43
NUT	1	39	40	79	
	2	38	39	77	
	3	39	38	77	
				233	39
SPACER	30	60	64	124	62
SPACER	31	54	58	112	56

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	16	9		
	2	14	14		
	3	14	17		
				16	21.3
NUT	1	21	20		
	2	15	21		
	3	22	17		
				19.3	25.7
SPACER	30	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	31	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº: 6 NUT Nº: EB-202

AN STD. Nº: MS 20020-50 SPACER Nº: 32 & 33

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	44	44	88	
	2	44	40	84	
	3	40	43	83	
					43
NUT	1	30	33	63	
	2	34	34	68	
	3	27	29	56	
				187	31
SPACER	32	59	55	114	57
SPACER	33	59	59	118	59

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	9	11		
	2	9	8		
	3	6	6		
				8.2	10.9
NUT	1	48	50		
	2	42	45		
	3	45	45		
				45.8	60.9
SPACER	32	(1) AVERAGE R.M.S. -20.1 SEE PAGE			
SPACER	33	(1) AVERAGE R.M.S. -20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº M NUT Nº EB-222

AN STD. Nº MS 20022-50 SPACER Nº 34 & 35

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	36	38	74	
	2	42	42	84	
	3	38	38	76	
				234	39
NUT	1	27	29	56	
	2	28	29	57	
	3	29	29	58	
				171	28.5
SPACER	34	60	63	123	62
SPACER	35	62	66	128	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	17	15		
	2	16	14		
	3	13	16		
				15.1	20.1
NUT	1	52	60		
	2	60	53		
	3	40	40		
				51	67.8
SPACER		(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER		(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

MS SERIES BOLT

CODE Nº. N NUT Nº. EB-242

AN STD. Nº. MS 20024-50 SPACER Nº. 36 & 37

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	38	39	77	
	2	40	40	80	
	3	39	41	80	
				237	39.5
NUT	1	28	24	52	
	2	29	31	60	
	3	29	31	60	
				172	28.6
SPACER	36	63	66	129	65
SPACER	37	58	61	119	60

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	14	14		
	2	13	12		
	3	12	12		
				12.8	17
NUT	1	55	60		
	2	55	50		
	3	45	40		
				51	67.8
SPACER		(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER		(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº: 0 NUT Nº: AN 365-832

AN STD. Nº: AN 509-8R37 SPACER Nº: 1 & 2

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	29	31	60	
	2	35	32	67	
	3	29	29	58	
				185	31
NUT	1	37	22	59	
	2	19	16	35	
	3	20	22	42	
				136	23
SPACER	1	59	59	118	59
SPACER	2	59	61	120	60

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	22	25		
	2	57	60		
	3	45	38		
				41.1	54.7
NUT	1	11	14		
	2	20	15		
	3	22	18		
				16.6	22.1
SPACER	1	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	2	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº. P

NUT Nº. AN 365-1032

AN STD. Nº. AN 509-10R37

SPACER Nº. 3 & 4

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	35	36	71	
	2	33	34	67	
	3	32	34	66	
				204	34
NUT	1	21	22	43	
	2	22	21	43	
	3	23	22	45	
				131	22
SPACER	3	63	63	126	63
SPACER	4	62	63	125	63

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	15	17		
	2	12	10		
	3	15	17		
				14.3	19
NUT	1	26	33		
	2	18	25		
	3	26	19		
				24.5	32.6
SPACER	3	(1) AVERAGE R.M.S. -20.1 SEE PAGE			
SPACER	4	(1) AVERAGE R.M.S. -26.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº: Q — NUT Nº: AN 365-428

AN STD. Nº: AN 509-416 R 37 — SPACER Nº: 5 & 6

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	35	36	71	
	2	32	33	65	
	3	33	31	64	
				200	33
NUT	1	18	17	35	
	2	11	9	20	
	3	18	18	36	
				91	15
SPACER	5	63	63	126	63
SPACER	6	63	64	127	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	22	17		
	2	11	13		
	3	12	12		
				14.5	19.3
NUT	1	12	13		
	2	18	24		
	3	17	20		
				17.3	23
SPACER	5	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	6	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº. R NUT Nº. AN365-524

AN STD. Nº. AN509-516R48 SPACER Nº. 7 & 8

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	35	36	70	
	2	35	35	70	
	3				
				140	35
NUT	1	27	27	54	
	2	25	25	50	
	3				
				104	26
SPACER	7	64	64	128	64
SPACER	8	65	66	131	66

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	23	15		
	2	21	17		
	3				
				19	25.3
NUT	1	19	20		
	2	25	24		
	3				
				22	29.3
SPACER	7	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	8	(1) AVERAGE R.M.S.-26.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº: 5 NUT Nº: AN 365-624

AN STD Nº: AN 509-616 R48 SPACER Nº: 9 & 10

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	29	29	58	
	2	29	31	60	
	3	30	31	61	
				179	30
NUT	1	14	18	32	
	2	20	24	44	
	3	22	24	46	
				122	20
SPACER	9	61.	58	119	60
SPACER	10	66	66	132	66

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	18	21		
	2	36	21		
	3	25	20		
				23.5	31.3
NUT	1	28	25		
	2	25	30		
	3	27	26		
				26.8	35.6
SPACER	9	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	10	(1) AVERAGE R.M.S. - 83.5 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº: T

NUT Nº: AN 365-720

AN STD. Nº: AN 509-716 R48

SPACER Nº: 11 & 12

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	30	28	58	
	2	29	29	58	
	3	29	30	59	
				175	29
NUT	1	26	29	55	
	2	28	31	59	
	3	28	26	54	
				168	28
SPACER	11	63	62	125	62.5
SPACER	12	62	63	125	62.5

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. X 1.33
BOLT	1	22	32		
	2	45	48		
	3	60	43		
				41.7	55.5
NUT	1	23	28		
	2	25	28		
	3	22	17		
				23.8	31.7
SPACER	11	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	12	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº: U — NUT Nº: AN 365-820

AN STD. Nº: AN 509-816R49 — SPACER Nº: 13 & 14

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	32	36	68	
	2	36	37	73	
	3	36	38	74	
				215	36
NUT	1	19	21	40	
	2	19	21	40	
	3	17	20	37	
				117	20
SPACER	13	64	64	128	64
SPACER	14	64	66	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	22	19		
	2	22	21		
	3	27	22		
				22.1	29.4
NUT	1	16	20		
	2	20	20		
	3	22	24		
				20.3	27
SPACER	13	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	14	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº. V

NUT Nº. AN 365-918

AN STD. Nº. AN 509-916 R52

SPACER Nº. 15 & 16

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	33	35	68	
	2	32	35	67	
	3	32	35	67	
				202	34
NUT	1	15	16	31	
	2	19	20	39	
	3	17	16	33	
				103	17
SPACER	15	63	64	127	64
SPACER	16	46	51	97	49

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. X 1.33
BOLT	1	38	32		
	2	37	33		
	3	27	30		
				32.8	43.6
NUT	1	22	25		
	2	28	37		
	3	27	23		
				27	35.9
SPACER	15	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	16	(1) AVERAGE R.M.S. - 83.5 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº: W — NUT Nº: NMJ-82

AN STD. Nº: AN509 8R37 — SPACER Nº: 162

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	21	29	50	
	2	32	34	66	
	3	31	33	64	
				180	30
NUT	1	7	7	14	
	2	9	9	18	
	3	8	5	13	
				45	8
SPACER	1	59	59	118	59
SPACER	2	59	61	120	60

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	41	30		
	2	40	40		
	3	30	32		
				35.5	47.2
NUT	1	4	3		
	2	5	5		
	3	4	4		
				4.2	5.6
SPACER	1	(1) AVERAGE R.M.S. 20.1 SEE PAGE			
SPACER	2	(1) AVERAGE R.M.S. 26.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE NO. X NUT NO. NMJ-02

AN STD. NO. AN 509 10 R 37 SPACER NO. 3 & 4

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. NO	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	32	34	66	
	2	29	34	63	
	3				
				129	32
NUT	1	9	9	18	
	2	5	6	11	
	3				
				29	7
SPACER	3	63	63	126	63
SPACER	4	62	63	125	63

SURFACE FINISH (R.M.S.)

ITEM	SPEC. NO	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	14	17		
	2	11	14		
	3				
				14	18.6
NUT	1	12	10		
	2	8	8		
	3				
				9.5	12.6
SPACER	3	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	4	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN 509 SERIES BOLT

CODE Nº. Y NUT Nº. NMJ-048

AN STD. Nº. AN 509 416 R37 SPACER Nº. 5 & 6

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	34	35	69	
	2	34	34	68	
	3	33	33	66	
				203	34
NUT	1	10	9	19	
	2	11	10	21	
	3	9	9	18	
				58	10
SPACER	5	63	63	126	63
SPACER	6	63	64	127	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	12	10		
	2	11	14		
	3	16	18		
				13.5	18
NUT	1	10	8		
	2	7	9		
	3	10	9		
				8.8	11.7
SPACER	5	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	6	(1) AVERAGE R.M.S. - 26.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº. A-A

NUT Nº. AN363C1032

AN STD. Nº. AN3C-30

SPACER Nº. (2)-1AC

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	30	28	58	
	2	29	30	59	
	3	29	30	59	
				176	29
NUT	1	20	23	43	
	2	19	24	43	
	3	25	26	51	
				137	23
SPACER	1-AC	65	65	130	65
SPACER	1-AC	65	65	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	9	12		
	2	9	13		
	3	10	14		
				11.2	14.9
NUT	1	16	21		
	2	17	17		
	3	15	17		
				17.2	22.9
SPACER	1-AC	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	1-AC	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº. B-B

NUT Nº. AN363C-428

AN STD. Nº. AN 4C-30

SPACER Nº. (2) - 1Bc

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	34	35	69	
	2	32	35	67	
	3	35	35	70	
				206	34
NUT	1	30	28	58	
	2	27	26	53	
	3	26	26	52	
				163	27
SPACER	1-Bc	65	65	130	65
SPACER	1-Bc	64	64	128	64

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	12	18		
	2	13	11		
	3	10	7		
				11.8	15.7
NUT	1	17	16		
	2	20	20		
	3	15	21		
				18.1	24.1
SPACER	1-Bc	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	1-Bc	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº: C-C

NUT Nº: AN 363C-524

AN STD. Nº: AN 5C-35

SPACER Nº: (2) - 2Ac

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	36	37	73	
	2	34	33	67	
	3	33	32	65	
				205	34
NUT	1	32	32	64	
	2	29	28	57	
	3	31	31	62	
				183	31
SPACER	2-Ac	65	65	130	65
SPACER	2-Ac	64	65	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	8	5		
	2	7	11		
	3	5	6		
				7	9.3
NUT	1	19	21		
	2	23	21		
	3	22	19		
				20.9	27.8
SPACER	2-Ac	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	2-Ac	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº: 0-D

NUT Nº: AN363C-624

AN STD. Nº: AN6C-36

SPACER Nº: 2BC & 2B

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	31	34	65	
	2	34	35	69	
	3	32	33	65	
				199	33
NUT	1	28	27	55	
	2	27	27	54	
	3	29	29	58	
				167	28
SPACER	2-Bc	64	65	129	65
SPACER	2-B	65	65	130	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	21	24		
	2	24	25		
	3	18	20		
				22	29.3
NUT	1	15	20		
	2	22	25		
	3	18	16		
				19.3	25.7
SPACER	2-Bc	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	2-B	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN ____ SERIES BOLT

CODE Nº: E-E

NUT Nº: AN 363C-720

AN STD. Nº: AN 7C-36

SPACER Nº: 2 Cc & 2 C

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	34	35	69	
	2	35	36	71	
	3	34	35	69	
				209	35
NUT	1	28	28	56	
	2	25	26	51	
	3	28	27	55	
				162	27
SPACER	2-C	63	64	127	64
SPACER	2-Cc	64	65	129	65

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	35	45		
	2	19	14		
	3	13	16		
				23.6	31.4
NUT	1	9	11		
	2	20	17		
	3	14	16		
				14.5	19.3
SPACER	2-C	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	2-Cc	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº F-F

NUT Nº AN 363C-820

AN STD. Nº AN8C-37

SPACER Nº 2 Dc & 2 D

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	29	30	59	
	2	31	32	63	
	3	31	31	62	
				184	31
NUT	1				
	2				
	3	31	33	64	
				64	32
SPACER	2-Dc	64	64	128	64
SPACER	2-D	63	63	126	63

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	13	17		
	2	12	13		
	3	16	16		
				14.5	19.3
NUT	1				
	2				
	3	20	16		
				18	23.9
SPACER	2-Dc	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	2-D	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº: G-G

NUT Nº: AN 363C-918

AN STD. Nº: AN 9C-37

SPACER Nº: 17 & 18

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	31	30	61	
	2	31	32	63	
	3	30	31	61	
				185	31
NUT	1	23	25	48	
	2	27	25	52	
	3	24	27	51	
				151	25
SPACER	17	54	57	111	56
SPACER	18	54	61	115	58

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. X 1.33
BOLT	1	23	26		
	2	22	25		
	3	15	21		
				22	29.3
NUT	1	18	20		
	2	23	17		
	3	17	16		
				18.5	24.6
SPACER	17	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	18	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº: H-H

NUT Nº: AN363C-1018

AN STD. Nº: AN 10C-37

SPACER Nº: 19 & 20

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	35	35	70	
	2	34	35	69	
	3	35	35	70	
				209	35
NUT	1	26	26	52	
	2	23	23	46	
	3	19	19	38	
				136	23
SPACER	19	62	61	123	62
SPACER	20	57	58	115	58

SURFACE FINISH (R.M.S.)

ITEM	SPEC Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. X 1.33
BOLT	1	12	11		
	2	10	9		
	3	13	10		
				10.9	14.5
NUT	1	16	17		
	2	17	19		
	3	16	22		
				17.8	23.7
SPACER	19	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	20	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº. I-I

NUT Nº. AN363C-1216

AN STD. Nº. AN12C-41

SPACER Nº. 22 & 23

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	32	32	64	
	2	31	30	61	
	3	32	31	63	
				188	31
NUT	1	29	29	58	
	2	30	30	60	
	3	28	29	57	
				175	29
SPACER	22	61	57	118	59
SPACER	23	60	61	121	61

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. X 1.33
BOLT	1	13	13		
	2	20	15		
	3	13	14		
				14.7	19.6
NUT	1	14	17		
	2	15	20		
	3	21	22		
				18.1	24.1
SPACER	22	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	23	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº: J-J

NUT Nº: AN310C-14

AN STD. Nº: AN14C-42

SPACER Nº: 25 & 26

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST READING	2ND READING	TOTAL	AVERAGE
BOLT	1	32	32	64	
	2	30	34	64	
	3	30	32	62	
				190	32
NUT	1	30	31	61	
	2	31	30	61	
	3	29	29	58	
				180	30
SPACER	25	60	59	119	60
SPACER	26	59	59	118	59

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. x 1.33
BOLT	1	21	19		
	2	19	21		
	3	19	20		
				19.8	26.3
NUT	1	21	33		
	2	27	22		
	3	28	27		
				26.3	35
SPACER	25	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	26	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº: K-K

NUT Nº: AN310C-16

AN STD. Nº: AN16C-42

SPACER Nº: 28 & 29

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	32	34	66	
	2	31	32	63	
	3	32	32	64	
				193	32
NUT	1	23	24	47	
	2	27	24	51	
	3	24	23	47	
				145	24
SPACER	28	67	67	134	67
SPACER	29	56	57	113	57

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	(1) AVERAGE	(1) AVE. X 1.33
BOLT	1	16	16		
	2	25	18		
	3	24	21		
				20	26.6
NUT	1	18	16		
	2	12	11		
	3	15	23		
				15.9	21.1
SPACER	28	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	29	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº: L-L

NUT Nº: AN 310C-18

AN STD. Nº: AN 18C-44

SPACER Nº: 30 & 31

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	30	30	60	
	2	28	31	59	
	3	32	32	64	
				183	31
NUT	1	20	22	42	
	2	24	21	45	
	3	19	19	38	
				125	21
SPACER	30	60	64	124	62
SPACER	31	54	58	112	56

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	10	12		
	2	10	10		
	3	11	21		
				12.3	16.4
NUT	1	16	11		
	2	15	14		
	3	17	13		
				14.3	19
SPACER	30	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			
SPACER	31	(1) AVERAGE R.M.S. - 20.1 SEE PAGE			

NOTE:
(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

DATA SHEET

HARDNESS & SURFACE FINISH

AN SERIES BOLT

CODE Nº: M-M

NUT Nº: AN 310C-20

AN STD. Nº: AN 20C-45

SPACER Nº: 32 & 33

HARDNESS: ROCKWELL "C" SCALE, 150 KG. LOAD

ITEM.	SPEC. Nº	1ST. READING	2ND READING	TOTAL	AVERAGE
BOLT	1	26	31	57	
	2	25	27	52	
	3	26	28	54	
				163	27
NUT	1	26	24	50	
	2	28	29	57	
	3	28	28	56	
				163	27
SPACER	32	59	55	114	57
SPACER	33	59	59	118	59

SURFACE FINISH (R.M.S.)

ITEM	SPEC. Nº	1ST READING	2ND READING	AVERAGE	(1) AVE. x 1.33
BOLT	1	17	12		
	2	14	14		
	3	15	13		
				14.2	18.9
NUT	1	14	23		
	2	47	32		
	3	40	32		
				31.3	41.6
SPACER	32	(1) AVERAGE R.M.S.-20.1 SEE PAGE			
SPACER	33	(1) AVERAGE R.M.S.-20.1 SEE PAGE			

NOTE:

(1) READING CORRECTED TO PROFILOMETER CALIBRATION.

APPENDIX III

DATA SHEETS
of
TORQUE TENSION RELATIONSHIPS

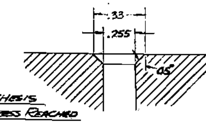
DATE — 16 APRIL 1956
SIZE — A, 1/4"-28 UNF-3A
SCREW OR BOLT — MS 20004-42 MFTD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — EB-048 " " ELASTIC STOP NUT CORP., UNION, N.J.

TEST CELL — NO.
TORSION — 7B
COMPRESSION — 5A

TEST DATA

CONTRACT NO. AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS
DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD
FILLET CLEARANCE IN HARDENED
STEEL SPACING BLOCK
(ROCKWELL "C" - SCALE 60)

A

NON LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	110,000 Torque (in.-#)	Theoretical Yield Point 140,000 Torque (in.-#)
Initial Torquing	1H	23	54	85	121	160	199	
	2H	25	57	94	132	170	210	
	3H	20	57	94	126	161	199	
	4H	26	59	92	124	158	201	
	5H	21	52	85	120	153	190	
	Ave.	23	56	90	125	160	200	
	Max.	26	59	94	132	170	210	
	Min.	21	52	85	120	153	190	
2nd Torquing	1H	47	111	163	201	242 (1)	6th point not attempted	
	2H	44	107	160	205	244 (1)		
	3H	37	104	154	200	241 (1)		
	4H	46	105	159	203	244 (1)		
	5H	50	114	163	204	240 (1)		
	Ave.	45	108	160	203	242		
	Max.	50	114	163	205	244		
	Min.	37	104	154	200	240		
3rd Torquing	1H	54	132	186	(2)	5th point not attempted		
	2H	44	117	169	219 (1)			
	3H	41	119	175	223 (1)			
	4H	51	120	170	219 (1)			
	5H	51	125	180	223 (1)			
	Ave.	48	123	176	221			
	Max.	54	132	186	223			
	Min.	41	117	169	219			
4th Torquing	1H	Test discontinued due to ruptured head						
	2H	46	125	174	220 (1)	5th point not attempted		
	3H	46	134	190	234 (1)			
	4H	47	117	170	216 (1)			
	5H	52	130	176	226 (1)			
	Ave.	48	127	178	224			
	Max.	52	134	190	234			
	Min.	46	117	170	216			
5th Torquing	1H	Test discontinued due to ruptured head L						
	2H	55	129	175	217	266	6th point not attempted	
	3H	50	133	191	235	273		
	4H	54	124	172	218	258		
	5H	55	135	196	230	261		
	Ave.	54	130	184	225	265		
	Max.	55	135	196	235	273		
	Min.	50	124	172	217	258		

NON LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	110,000 Torque (in.-#)	Theoretical Yield Point 140,000 Torque (in.-#)
Initial Torquing	1N	13	38	70	105	152	200	
	2N	21	56	94	141	198	246	
	3N	27	78	126	189	266	341	
	4N	26	60	108	178	243	324	
	5N	25	77	128	194	264	335	
	Ave.	22	62	105	161	225	289	
	Max.	27	78	128	194	266	341	
	Min.	13	38	70	105	152	200	
2nd Torquing	1N	27	81	130	174	220	373	
	2N	53	132	202	269	322	374	
	3N	70	178	266	352	436	500	
	4N	58	140	215	274	365	412	
	5N	35	141	215	277	342	411	
	Ave.	49	134	206	269	337	414	
	Max.	70	178	266	352	365	500	
	Min.	27	81	130	174	220	373	
3rd Torquing	1N	41	96	133	175	222	372	
	2N	60	165	255	341	405	460	
	3N	71	191	309	375	467	527	
	4N	59	149	225	310	390	452	
	5N	60	166	246	321	395	474	
	Ave.	58	153	234	304	376	457	
	Max.	71	191	309	375	467	527	
	Min.	41	96	133	175	222	372	
4th Torquing	1N	38	95	140	184	236	290	
	2N	73	188	282	366	421	471	
	3N	71	195	295	396	486	550	
	4N	65	161	246	325	407	484	
	5N	76	182	270	356	425	505	
	Ave.	65	164	247	325	395	460	
	Max.	76	195	295	396	486	550	
	Min.	38	95	140	184	236	290	
5th Torquing	1N	39	100	147	197	246	306	356
	2N	74	173	272	355	427	467	510
	3N	77	205	311	406	492	555	597
	4N	68	170	261	337	428	516	551
	5N	71	186	277	366	453	531	623
	Ave.	66	167	254	332	409	475	527
	Max.	77	205	311	406	492	555	623
	Min.	39	100	147	197	246	306	356

LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	110,000 Torque (in.-#)	Theoretical Yield Point 140,000 Torque (in.-#)
Initial Torquing	1H-L	L (3) 7	22	38	56	79	96	
	2H-L	L 5	19	31	45	60	80	
	3H-L	L 6	18	35	52	69	88	
	4H-L	L 10	25	40	55	72	90	
	5H-L	L 7	24	41	55	69	85	
	Ave.	7	22	37	53	70	88	
	Max.	10	25	41	56	79	96	
	Min.	5	18	31	45	60	80	
2nd Torquing	1H-L	9	25	40	56	74	94	
	2H-L	7	21	36	52	69	86	
	3H-L	7	20	34	52	70	89	
	4H-L	11	28	43	55	74	91	
	5H-L	10	25	39	54	67	85	
	Ave.	9	24	38	54	71	89	
	Max.	11	28	43	56	74	94	
	Min.	7	20	34	52	67	85	
3rd Torquing	1H-L	10	29	43	62	81	101	
	2H-L	9	24	39	55	73	92	
	3H-L	8	23	38	54	75	91	
	4H-L	12	31	46	61	77	93	
	5H-L	11	26	43	57	72	88	
	Ave.	10	27	42	58	76	93	
	Max.	12	31	46	62	81	101	
	Min.	8	23	38	54	72	88	
4th Torquing	1H-L	L 6	26	32	49	66	86	
	2H-L	L 5	19	31	45	61	78	
	3H-L	L 6	18	30	46	61	79	
	4H-L	L 10	25	39	55	71	90	
	5H-L	L 9	23	37	50	63	72	
	Ave.	7	22	34	49	64	81	
	Max.	10	26	39	55	71	90	
	Min.	5	18	30	45	61	72	
5th Torquing	1H-L	8	27	41	60	78	100	129
	2H-L	8	22	37	57	73	90	119
	3H-L	6	20	36	53	71	90	112
	4H-L	12	30	46	63	79	93	121
	5H-L	11	27	40	55	66	83	104
	Ave.	9	25	40	58	73	91	117
	Max.	12	30	46	63	79	100	129
	Min.	6	20	36	53	66	83	104

LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	110,000 Torque (in.-#)	Theoretical Yield Point 140,000 Torque (in.-#)
Initial Torquing	1N-L	L (3) 7	19	38	61	95	113	
	2N-L	L 5	20	45	80	90	105	
	3N-L	L 6	20	35	55	90	135	
	4N-L	L 7	19	35	53	73	103	
	5N-L	L 6	19	32	50	73	110	
	Ave.	6	19	37	60	84	113	
	Max.	7	20	45	80	95	135	
	Min.	5	19	32	50	73	103	
2nd Torquing	1N-L	10	25	45	70	109	110	
	2N-L	7	25	44	70	91	119	
	3N-L	11	28	46	72	108	122	
	4N-L	10	27	44	63	87	117	
	5N-L	12	29	45	62	93	132	
	Ave.	10	27	45	67	98	120	
	Max.	12	29	46	72	109	132	
	Min.	7	25	44	63	87	110	
3rd Torquing	1N-L	11	29	50	74	117	117	
	2N-L	9	29	53	79	99	127	
	3N-L	14	33	54	79	105	136	
	4N-L	10	29	45	66	90	119	
	5N-L	13	36	56	75	101	140	
	Ave.	11	31	52	75	102	128	
	Max.	14	36	56	79	117	140	
	Min.	9	29	45	66	90	117	
4th Torquing	1N-L	L 6	16	32	49	71	109	
	2N-L	L 6	14	27	55	90	132	
	3N-L	L 8	19	34	51	71	97	
	4N-L	L 8	20	34	51	75	116	
	5N-L	L 9	20	32	49	69	95	
	Ave.	7	18	32	51	75	110	
	Max.	9	20	34	55	90	132	
	Min.	6	14	27	49	69	95	
5th Torquing	1N-L	12	25	40	59	95	125	149
	2N-L	8	26	44	70	109	118	148
	3N-L	12	30	45	64	85	120	173
	4N-L	11	29	45	65	95	129	174
	5N-L	13	35	50	70	89	115	170
	Ave.	11	29	45	66	95	121	163
	Max.	13	35	50	70	109	129	173
	Min.	9	25	40	59	85	115	148

COMMENTS:
1. Non-lubricated head torqued bolts 2H-5H were torqued to values less than that which caused rupture of the socket type heads by the torquing tool. Rupturing value of torque in range of 250-270 in-lb.
2. Bolt 1H socket head was ruptured by the tool during 3rd torquing. Test on bolt 1H discontinued.
3. Runs of lubricated torquings are marked with an "L" at the beginning of the run to indicate initial lubrication and subsequent lubrications of nut or head bearing surfaces.
4. Spacer blocks were sanded at the end of the 5th torquing of each specimen for the dry conditions only due to scarring.

PAGE NO.

WADC TR 57-330

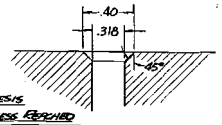
88

DATE — 6 APRIL 1956
SIZE — B, 5/16-24 UNF-3A
SCREW OR BOLT — MS 20005-50 MFTD. BY AIRCRAFT BOLT CO., EL MONTE, CAL.
NUT — EB-054 " " ELASTIC STOP NUT CORP, UNION, N.J.

TEST CELL — N9:
TORSION — 78
COMPRESSION — 58

TEST DATA
CONTRACT Nº AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

B

NON LUBRICATED

TORQUED FROM HEAD

TORQUING Nº	SPECIMEN Nº	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	110,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 140,000 TORQUE (IN.-#)
INITIAL TORQUING	1H	63	195	232	328	915	492	
	2H	67	131	199	249	309	382	
	3H	60	130	192	249	308	394	
	4H	74	100	218	283	331	486	
	5H	64	139	199	262	321	387	
	AVE.	66	128	207	274	337	424	
	MAX.	74	145	232	328	415	486	
	MIN.	60	100	192	249	309	382	
2ND TORQUING	1H	109	253	358	456	(97,500 PSI) 495(1)	(RUPTURED HEAD)	
	2H	100	230	311	392	467(1)	"	
	3H	89	209	302	373	467	525	
	4H	92	283	336	400	465	516	
	5H	89	211	305	410	490	6TH PT. NOT ATTEMPTED	
	AVE.	96	225	322	406	477	520	
	MAX.	109	253	358	456	495	535	
	MIN.	89	209	302	373	465	516	
3RD TORQUING	1H	TEST DISCONTINUED DUE TO INTERNAL RUPTURE OF HEAD.						
	2H	"	"	"	"	"	"	"
	3H	95	240	336	444	535(2)	RUPTURED HEAD	
	4H	109	255	369	469	532	(104,500 PSI) 552 (2)	
	5H	105	250	389	489	5TH POINT NOT ATTEMPTED		
	AVE.	101	248	365	464	534	(104,500 PSI) 552	
	MAX.	105	255	389	484	535	"	
	MIN.	95	240	336	444	532	"	
4TH TORQUING	1H							
	2H							
	3H	TEST DISCONTINUED DUE TO INTERNAL RUPTURE OF HEAD BY TOOL						
	4H	"	"	"	"	"	"	"
	5H	110	285	419	494	5TH POINT NOT ATTEMPTED 1/4 HEAD RUPTURING HERE		
	AVE.	110	285	419	494			
	MAX.	110	285	419	494			
	MIN.	110	285	419	494			
5TH TORQUING	1H							
	2H							
	3H							
	4H							
	5H	97	273	389	487	562	(93,150 PSI) 567	RUPTURED HEAD BY TOOL
	AVE.	97	273	389	487	562	(93,150 PSI) 567	
	MAX.	97	273	389	487	562	567	
	MIN.	97	273	389	487	562	567	

TORQUED FROM NUT

SPECIMEN Nº	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	110,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 140,000 TORQUE (IN.-#)
1N	37	100	180	260	345	405	
2N	58	134	224	338	446	516	
3N	50	129	230	322	412	476	
4N	60	123	223	327	447	562	
5N	45	120	216	332	472	565	
AVE.	46	121	215	316	424	505	
MAX.	58	134	224	338	472	565	
MIN.	37	100	180	260	345	405	
1N	80	178	277	365	432	495	
2N	90	225	350	479	562	623	
3N	85	227	341	447	521	583	
4N	84	212	326	431	546	562	
5N	85	218	340	474	625	697	
AVE.	85	211	327	439	537	592	
MAX.	90	227	350	479	625	697	
MIN.	80	178	277	365	432	495	
1N	90	212	310	400	475	530	
2N	119	386	434	565	670	747	
3N	109	290	432	554	637	706	
4N	105	298	442	545	692	826	
5N	105	267	427	604	730	801	
AVE.	105	291	409	534	641	722	
MAX.	119	386	442	604	730	826	
MIN.	90	212	310	400	475	530	
1N	95	220	327	425	500	545	
2N	128	318	464	615	714	894	
3N	118	323	465	581	681	753	
4N	122	317	486	623	770	917	
5N	115	336	522	698	815	881	
AVE.	116	303	453	588	696	798	
MAX.	128	336	522	648	815	917	
MIN.	95	220	327	425	500	545	
1N	100	225	320	410	487	538	625
2N	122	328	489	640	763	827	905
3N	134	335	470	599	689	759	847
4N	130	339	507	660	832	975	1075
5N	128	346	566	741	849	919	980
AVE.	123	315	470	609	724	804	886
MAX.	134	346	566	741	849	975	1075
MIN.	100	225	320	410	487	538	625

LUBRICATED

TORQUED FROM HEAD

SPECIMEN Nº	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	110,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 140,000 TORQUE (IN.-#)
1H-L (3)	12	30	52	78	105	127	
2H-L	10	28	50	77	105	128	
3H-L	15	35	60	92	123	152	
4H-L	10	28	53	75	97	123	
5H-L	19	43	66	99	131	165	
AVE.	13	33	56	82	112	139	
MAX.	19	43	66	99	131	165	
MIN.	10	28	50	75	97	123	
1H-L	13	37	65	82	105	127	
2H-L	12	40	65	85	120	140	
3H-L	22	55	78	105	145	170	
4H-L	12	35	58	77	98	123	
5H-L	21	40	58	87	119	147	
AVE.	16	41	65	87	117	141	
MAX.	22	55	78	105	145	170	
MIN.	12	35	58	77	98	123	
1H-L	8	25	48	73	97	122	
2H-L	5	25	50	75	105	127	
3H-L	10	35	62	82	122	168	
4H-L	7	28	55	77	103	123	
5H-L	13	31	50	79	112	144	
AVE.	9	29	53	77	108	137	
MAX.	13	35	62	82	122	168	
MIN.	5	25	48	73	97	122	
1H-L	10	35	62	80	102	125	
2H-L	8	37	70	92	110	132	
3H-L	15	47	70	100	128	155	
4H-L	12	38	67	88	117	136	
5H-L	17	36	57	84	116	156	
AVE.	12	39	65	89	115	141	
MAX.	17	47	70	100	128	156	
MIN.	8	35	57	80	102	125	
1H-L	5	25	53	75	100	125	155
2H-L	7	32	67	85	123	148	190
3H-L	12	35	57	87	120	137	177
4H-L	10	25	50	75	98	123	153
5H-L	14	30	53	87	126	151	209
AVE.	10	29	56	82	113	137	177
MAX.	14	35	67	87	126	151	209
MIN.	5	25	50	75	98	123	153

TORQUED FROM NUT

SPECIMEN Nº	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	110,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 140,000 TORQUE (IN.-#)
1N-L (3)	15	30	55	85	105	135	
2N-L	10	25	48	75	102	127	
3N-L	10	23	50	73	103	130	
4N-L	10	27	47	76	105	132	
5N-L	12	28	53	72	100	127	
AVE.	11	27	51	76	103	130	
MAX.	15	30	55	85	105	135	
MIN.	10	23	47	72	100	127	
1N-L	20	50	73	102	137	162	
2N-L	15	35	63	83	110	135	
3N-L	12	37	65	95	123	152	
4N-L	12	32	60	83	122	150	
5N-L	19	45	63	90	123	147	
AVE.	15	40	65	91	123	149	
MAX.	20	50	73	102	137	162	
MIN.	12	32	60	83	110	135	
1N-L	10	30	55	77	112	OPERATOR ERROR	
2N-L	8	23	48	70	100	127	
3N-L	10	21	43	74	102	128	
4N-L	10	24	50	77	108	140	
5N-L	8	27	48	73	102	127	
AVE.	9	25	49	74	105	131	
MAX.	10	30	55	77	112	140	
MIN.	8	21	43	70	100	127	
1N-L	10	30	55	80	110	140	
2N-L	13	35	62	88	122	145	
3N-L	14	42	68	90	128	158	
4N-L	13	40	67	93	125	148	
5N-L	15	45	72	95	122	147	
AVE.	13	38	65	89	121	148	
MAX.	15	45	72	95	128	158	
MIN.	10	30	55	80	110	140	
1N-L	20	45	70	102	135	160	215
2N-L	5	24	50	72	110	142	185
3N-L	15	28	48	75	102	132	183
4N-L	5	20	40	77	105	132	170
5N-L	8	25	50	73	97	128	173
AVE.	11	28	52	80	110	139	185
MAX.	20	45	70	102	135	160	215
MIN.	5	20	40	72	97	128	170

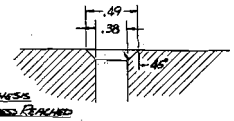
COMMENTS:
1. BOLT 1H & 2H SOCKET HEAD RUPTURED BY TORQUING TOOL AT END OF 2ND TORQUING. TEST ON 1H & 2H DISCONTINUED.
2. " 3H & 4H " " " " " " " " " " 3RD " " " 3H & 4H "
3. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF EACH TORQUING FOR INITIAL LUBRICATION & SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
4. SPACER BLOCKS WERE SANDED AT THE END OF THE 5TH TORQUING OF EACH COMBINATION FOR THE DRY CONDITIONS ONLY DUE TO SCORING.

DATE — 4 APRIL 1956
SIZE — C 3/8-24 UNF-3A
SCREW OR BOLT — MS 20006-50 MFTD BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — EB-064 " " ELASTIC STOP NUT CORP., UNION, N. J.

TEST CELL — No:
TORSION — 7A&7B
COMPRESSION — 5B

TEST DATA
CONTRACT N° AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C"-SCALE 60)

C

NON LUBRICATED

TORQUED FROM HEAD

SPECIMEN N°	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	110,000 TORQUE (in-#)	THEORETICAL YIELD PT. 140,000 TORQUE (in-#)
INITIAL TORQUING N° TORQUING							
1H	85	215	335	475	600	745	
2H	95	260	400	535	690	840	
3H	100	255	400	530	660	780	
4H	125	275	420	570	715	850	
5H	85	250	370	500	625	735	
AVE.	98	251	385	522	658	790	
MAX.	125	275	420	570	715	850	
MIN.	85	215	335	475	600	735	
2ND TORQUING							
1H	180	430	595	745	900	1025	
2H	195	440	630	780	950	1060	
3H	195	445	625	765	895	1010	
4H	225	475	650	805	960	985	
5H	195	425	600	725	815	995	
AVE.	198	443	620	764	904	1015	
MAX.	225	475	650	805	950	1060	
MIN.	180	425	595	725	815	985	
3RD TORQUING							
1H	200	450	630	770	900	1025	
2H	205	485	670	830	970	1100	
3H	185	475	670	820	950	1095	
4H	225	480	660	805	905	1005	
5H	185	465	650	790	920	1030	
AVE.	200	471	656	803	929	1041	
MAX.	225	485	670	830	970	1110	
MIN.	185	450	630	770	900	1005	
4TH TORQUING							
1H	210	465	695	800	930	1070	
2H	215	480	695	835	975	1105	
3H	200	475	650	795	920	1005	
4H	225	475	650	800	905	1005	
5H	205	470	655	800	925	1030	
AVE.	211	473	659	806	931	1043	
MAX.	225	480	695	835	975	1105	
MIN.	200	465	645	795	905	1005	
5TH TORQUING							
1H	195	470	650	820	960	1110	(25,300 PSI) 1300 (1)
2H	210	475	660	810	935	1050	(2)
3H	215	465	635	775	925	1030	(2)
4H	225	485	655	805	910	1010	(2)
5H	200	475	660	815	935	1060	(2) (25,300 PSI) 1300
AVE.	209	474	652	805	933	1052	
MAX.	225	485	660	820	960	1110	
MIN.	195	465	635	775	910	1010	

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	110,000 TORQUE (in-#)	THEORETICAL YIELD PT. 140,000 TORQUE (in-#)
1N	50	70	255	360	475	590	
2N	110	295	445	665	820	1000	
3N	80	205	325	470	610	800	
4N	95	255	445	605	790	955	
5N	75	215	345	530	695	830	
AVE.	82	208	363	526	678	835	
MAX.	110	295	445	665	820	1000	
MIN.	50	70	255	360	475	590	
1N	100	220	355	460	580	720	
2N	185	450	655	845	1025	1195	
3N	200	460	700	875	1045	1175	
4N	220	465	660	830	975	1115	
5N	180	450	635	790	925	1050	
AVE.	177	409	601	760	910	1051	
MAX.	220	465	700	875	1045	1195	
MIN.	100	220	355	460	580	720	
1N	120	280	425	535	680	810	
2N	235	530	755	960	1150	1300	
3N	215	520	750	950	1090	1200	
4N	225	490	690	865	1015	1140	
5N	195	475	670	830	970	1085	
AVE.	198	459	658	828	981	1107	
MAX.	235	530	755	960	1150	1300	
MIN.	120	280	425	535	680	810	
1N	125	315	445	580	710	825	
2N	250	550	780	990	1180	1320	
3N	230	550	760	980	1100	1210	
4N	250	495	705	890	1040	1150	
5N	210	515	780	875	1025	1130	
AVE.	213	485	682	863	1011	1127	
MAX.	250	550	780	990	1180	1320	
MIN.	125	315	445	580	710	825	
1N	130	300	445	585	710	825	1000
2N	295	585	780	1010	1165	1305	1475
3N	225	565	785	980	1110	1230	1930
4N	245	510	720	900	1095	1175	1325
5N	220	530	745	890	1040	1180	1375
AVE.	219	498	695	873	1014	1143	1321
MAX.	295	585	785	1010	1165	1305	1475
MIN.	130	300	445	585	710	825	1000

LUBRICATED

TORQUED FROM HEAD

SPECIMEN N°	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	110,000 TORQUE (in-#)	THEORETICAL YIELD PT. 140,000 TORQUE (in-#)
1H-L (3)	30	75	130	185	245	315	
2H-L	25	70	110	175	225	275	
3H-L	25	70	115	175	220	270	
4H-L	35	75	120	165	230	295	
5H-L	25	65	110	165	220	270	
AVE.	28	71	117	173	228	285	
MAX.	35	75	130	185	245	315	
MIN.	25	65	110	165	220	270	
1H-L	30	80	125	175	220	290	
2H-L	25	75	120	160	205	265	
3H-L	20	70	118	155	200	250	
4H-L	30	75	125	170	215	270	
5H-L	20	70	110	150	195	250	
AVE.	25	74	120	162	207	265	
MAX.	30	80	125	175	220	290	
MIN.	20	70	110	150	195	250	
1H-L	40	100	155	205	260	325	
2H-L	35	95	125	180	230	285	
3H-L	30	90	130	180	230	280	
4H-L	35	98	145	195	248	305	
5H-L	35	95	140	185	230	290	
AVE.	35	96	139	189	240	297	
MAX.	40	100	155	205	260	325	
MIN.	30	90	125	180	230	280	
1H-L	40	85	150	200	255	310	
2H-L	22	60	125	175	215	275	
3H-L	35	90	125	185	235	290	
4H-L	35	75	125	180	230	285	
5H-L	25	75	120	170	220	275	
AVE.	29	77	129	182	231	287	
MAX.	40	90	150	200	255	310	
MIN.	22	60	120	170	215	275	
1H-L	55	110	205	240	295	350	470
2H-L	40	100	150	200	250	300	430
3H-L	40	105	160	210	270	312	435
4H-L	40	85	155	210	260	320	485
5H-L	45	100	150	200	250	305	405
AVE.	44	100	164	212	265	317	433
MAX.	55	110	205	240	295	350	470
MIN.	40	85	150	200	250	300	405

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	110,000 TORQUE (in-#)	THEORETICAL YIELD PT. 140,000 TORQUE (in-#)
1N-L	25	60	90	125	200	275	
2N-L	25	65	95	130	185	250	
3N-L	35	80	130	180	225	280	
4N-L	23	60	95	135	190	250	
5N-L	25	70	115	160	208	270	
AVE.	27	67	105	146	202	265	
MAX.	35	80	130	180	225	280	
MIN.	23	60	90	125	185	250	
1N-L	35	85	145	185	250	310	
2N-L	20	50	90	140	190	250	
3N-L	20	65	120	175	225	275	
4N-L	30	70	110	160	218	285	
5N-L	30	60	110	160	210	275	
AVE.	27	66	115	164	217	279	
MAX.	35	85	145	185	250	310	
MIN.	20	50	90	140	190	250	
1N-L	25	60	80	160	215	275	
2N-L	35	80	130	180	230	295	
3N-L	40	100	165	205	255	300	
4N-L	25	60	95	130	190	250	
5N-L	35	80	130	190	235	295	
AVE.	32	76	120	173	225	283	
MAX.	40	100	165	205	255	300	
MIN.	25	60	80	130	190	250	
1N-L	35	85	130	200	245	295	
2N-L	25	50	90	140	200	270	
3N-L	25	65	115	170	220	265	
4N-L	35	80	125	170	205	275	
5N-L	30	70	115	175	225	280	
AVE.	30	70	115	171	219	277	
MAX.	35	85	130	200	245	295	
MIN.	25	50	90	140	200	265	
1N-L	25	50	80	158	210	275	382
2N-L	35	85	125	185	245	300	410
3N-L	50	110	165	215	260	300	390
4N-L	20	50	95	135	190	250	375
5N-L	40	100	145	190	250	300	390
AVE.	34	81	122	177	231	285	391
MAX.	50	110	165	215	260	300	410
MIN.	20	50	80	135	190	250	375

COMMENTS:
1. DRY TORQUED BOLT 1-H SPECIMEN SOCKET HEAD RUPTURED BY TORQUING TOOL BETWEEN 6TH POINT AND YIELD POINT AT 5TH TORQUING.
2. BOLTS 2H TO 5H WERE NOT TORQUED TO YIELD POINT TO AVOID RUPTURE OF SOCKET HEAD BY TORQUE WRENCH.
3. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF EACH TORQUING FOR INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
4. SPACER BLOCKS WERE SANDED AT THE END OF THE 5TH TORQUING OF EACH ASSEMBLY FOR THE DRY CONDITIONS ONLY DUE TO SCORING.

WADC TR 57-330

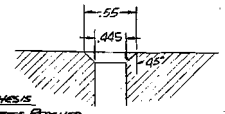
90

DATE — 2 APRIL 1956
SIZE — D 7/16-20 UNF-3A
SCREW OR BOLT — MS 20.007-50 MFTD. BY AIRCRAFT BOLT CORP, EL MONTE, CAL.
NUT — EB-070 " " ELASTIC STOP NUT CORP, UNION, N. J.

TEST CELL — Nº.
TORSION — 7487B
COMPRESSION — 5B

TEST DATA
CONTRACT Nº AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPRING BLOCK (ROCKWELL "C" - SCALE 60)

D

NON LUBRICATED

TORQUED FROM HEAD

	SPECIMEN Nº	TENSILE STRESS (#/in²) 10,000 TORQUE (lb-in)	30,000 TORQUE (lb-in)	50,000 TORQUE (lb-in)	70,000 TORQUE (lb-in)	90,000 TORQUE (lb-in)	110,000 TORQUE (lb-in)	THEORETICAL YIELD PT. 140,000 TORQUE (lb-in)
INITIAL TORQUING	1H	225	380	523	675	845	1030	
	2H	150	325	505	645	830	1030	
	3H	185	350	520	675	855	1050	
	4H	155	310	465	630	830	1100	
	5H	135	310	495	650	825	1010	
	AVE.	170	335	502	658	837	1044	
	MAX.	225	380	523	675	855	1100	
	MIN.	135	310	465	645	825	1010	
2ND TORQUING	1H	325	610	830	1045	1240	1440	
	2H	280	600	865	1100	1320	1550 (2)	
	3H	320	620	870	1075	1275	(3)	
	4H	300	645	920	1125	1400	(3)	
	5H	250	530	775	970	1150	1340	
	AVE.	295	601	852	1063	1277	1443	
	MAX.	325	645	920	1125	1400	1550	
	MIN.	250	530	775	970	1150	1340	
3RD TORQUING	1H	375	725	1000	1225	1445	(1)	
	2H	SOCKET HEAD RUPTURED BY TOOL AT END OF 2ND TORQ.						
	3H	350	720	985	1210	1440	(3)	
	4H	310	715	1025	1285	1500	(3)	
	5H	250	610	850	1085	1310	(3)	
	AVE.	321	693	965	1204	1424		
	MAX.	375	725	1025	1295	1500		
	MIN.	250	610	850	1085	1310		
4TH TORQUING	1H	SOCKET HEAD RUPTURED BY TOOL AT END OF 3RD TORQ.						
	2H							
	3H	330	745	1045	1285	1515	(3)	
	4H	330	745	1050	1340	(3)		
	5H	325	670	935	1180	1385	(3)	
	AVE.	328	720	1010	1268	1450		
	MAX.	330	745	1050	1340	1515		
	MIN.	325	670	935	1180	1385		
5TH TORQUING	1H							
	2H							
	3H	340	725	1035	1305	HEAD RUPTURED ON TOOL		
	4H	335	730	1050	1305	" "	" "	
	5H	310	675	950	1200	1410	HEAD RUPTURED	
	AVE.	328	710	1012	1270	1410		
	MAX.	340	730	1050	1305	1411		
	MIN.	310	675	950	1200	1410		

TORQUED FROM NUT

	SPECIMEN Nº	TENSILE STRESS (#/in²) 10,000 TORQUE (lb-in)	30,000 TORQUE (lb-in)	50,000 TORQUE (lb-in)	70,000 TORQUE (lb-in)	90,000 TORQUE (lb-in)	110,000 TORQUE (lb-in)	THEORETICAL YIELD PT. 140,000 TORQUE (lb-in)
INITIAL TORQUING	1N	115	270	420	605	770	960	
	2N	120	330	560	770	1010	1250	
	3N	195	460	700	920	1150	1370	
	4N	200	415	625	835	1050	1265	
	5N	225	500	761	1005	1295	1595	
	AVE.	171	395	613	819	1045	1259	
	MAX.	225	500	760	1005	1245	1450	
	MIN.	115	270	420	605	770	960	
2ND TORQUING	1N	265	560	775	950	1125	1255	
	2N	285	650	940	1215	1495	1650	
	3N	365	715	1000	1250	1475	1670	
	4N	315	620	870	1120	1330	1515	
	5N	345	740	1055	1365	1600	1805	
	AVE.	315	655	934	1181	1395	1585	
	MAX.	365	740	1085	1365	1600	1805	
	MIN.	265	550	775	950	1125	1285	
3RD TORQUING	1N	275	640	870	1090	1270	1465	
	2N	295	720	1065	1330	1565	1765	
	3N	415	730	1100	1350	1565	1770	
	4N	305	635	975	1215	1475	1700	
	5N	425	830	1285	1450	1700	1880	
	AVE.	343	711	1061	1285	1515	1716	
	MAX.	425	830	1285	1450	1700	1880	
	MIN.	275	635	880	1090	1270	1465	
4TH TORQUING	1N	325	675	1075	1330	1570	1740	
	2N	350	775	1230	1515	1565	1775	
	3N	420	1110	1110	1390	1620	1870	
	4N	330	665	955	1200	1495	1705	
	5N	430	830	1225	1505	1725	1945	
	AVE.	369	733	1079	1348	1585	1807	
	MAX.	430	830	1225	1505	1725	1945	
	MIN.	320	665	955	1200	1495	1705	
5TH TORQUING	1N	340	700	1000	1305	1555	1775	2015
	2N	375	785	1685	1330	1560	1750	2015
	3N	395	800	1150	1920	1710	1955	2100
	4N	315	665	930	1190	1450	1675	1960
	5N	390	800	1230	1495	1750	1970	2200
	AVE.	369	750	1079	1348	1605	1825	2058
	MAX.	395	800	1230	1495	1750	1970	2200
	MIN.	315	665	930	1190	1450	1675	1960

LUBRICATED

TORQUED FROM HEAD

	SPECIMEN Nº	TENSILE STRESS (#/in²) 10,000 TORQUE (lb-in)	30,000 TORQUE (lb-in)	50,000 TORQUE (lb-in)	70,000 TORQUE (lb-in)	90,000 TORQUE (lb-in)	110,000 TORQUE (lb-in)	THEORETICAL YIELD PT. 140,000 TORQUE (lb-in)
INITIAL TORQUING	1H-L	25	115	210	300	395	495	
	2H-L	25	120	175	275	390	495	
	3H-L	25	80	145	210	285	375	
	4H-L	30	75	145	205	275	370	
	5H-L	25	115	150	225	295	405	
	AVE.	26	93	165	243	318	414	
	MAX.	30	120	210	300	395	495	
	MIN.	25	75	145	205	275	370	
2ND TORQUING	1H-L	30	85	170	245	305	395	
	2H-L	25	95	165	235	315	390	
	3H-L	20	82	147	215	260	345	
	4H-L	40	95	170	240	310	390	
	5H-L	35	100	175	245	315	405	
	AVE.	30	91	165	232	309	395	
	MAX.	40	100	175	245	315	405	
	MIN.	20	82	147	215	300	390	
3RD TORQUING	1H-L	40	125	205	250	360	445	
	2H-L	90	120	210	275	370	450	
	3H-L	35	115	215	270	380	495	
	4H-L	30	100	135	225	280	380	
	5H-L	35	105	175	270	370	470	
	AVE.	36	113	188	256	345	428	
	MAX.	40	125	215	280	380	450	
	MIN.	30	100	135	225	280	380	
4TH TORQUING	1H-L	50	130	245	330	420	500	
	2H-L	45	190	240	330	425	515	
	3H-L	40	120	220	285	385	490	
	4H-L	35	105	190	255	325	395	
	5H-L	40	115	195	295	390	495	
	AVE.	42	120	218	279	379	469	
	MAX.	50	140	245	330	425	515	
	MIN.	35	105	190	245	325	395	
5TH TORQUING	1H-L	40	135	240	350	430	520	660
	2H-L	45	145	245	330	422	522	675
	3H-L	35	90	175	225	305	395	550
	4H-L	40	120	220	275	350	430	580
	5H-L	35	125	230	290	355	445	590
	AVE.	39	123	222	294	372	461	611
	MAX.	45	145	245	350	430	522	675
	MIN.	35	90	175	225	305	395	550

TORQUED FROM NUT

	SPECIMEN Nº	TENSILE STRESS (#/in²) 10,000 TORQUE (lb-in)	30,000 TORQUE (lb-in)	50,000 TORQUE (lb-in)	70,000 TORQUE (lb-in)	90,000 TORQUE (lb-in)	110,000 TORQUE (lb-in)	THEORETICAL YIELD PT. 140,000 TORQUE (lb-in)
INITIAL TORQUING	1N-L	35	80	160	240	330	450	
	2N-L	20	65	150	220	310	400	
	3N-L	35	100	170	235	315	395	
	4N-L	50	125	170	270	345	445	
	5N-L	25	105	150	220	295	385	
	AVE.	33	95	164	237	319	415	
	MAX.	50	125	190	270	345	450	
	MIN.	20	65	150	220	295	385	
2ND TORQUING	1N-L	50	135	225	320	420	515	
	2N-L	20	70	145	205	300	380	
	3N-L	25	80	145	210	300	380	
	4N-L	28	100	175	245	325	420	
	5N-L	25	75	140	215	280	390	
	AVE.	30	92	166	238	325	417	
	MAX.	50	135	225	320	420	515	
	MIN.	20	70	140	205	280	380	
3RD TORQUING	1N-L	25	75	150	230	320	425	
	2N-L	45	115	195	220	390	420	
	3N-L	45	120	180	250	360	445	
	4N-L	45	125	200	275	395	450	
	5N-L	35	115	190	260	335	400	
	AVE.	39	110	183	247	340	428	
	MAX.	45	125	200	275	360	450	
	MIN.	25	75	150	220	320	400	
4TH TORQUING	1N-L	40	130	220	302	380	495	
	2N-L	50	125	200	275	350	445	
	3N-L	60	145	220	300	380	495	
	4N-L	55	135	205	275	345	450	
	5N-L	50	140	220	290	370	470	
	AVE.	51	135	213	288	365	471	
	MAX.	60	145	220	302	380	495	
	MIN.	40	125	200	275	345	445	
5TH TORQUING	1N-L	50	145	230	330	435	525	670
	2N-L	60	135	205	280	360	445	595
	3N-L	75	145	215	320	405	595	
	4N-L	40	110	185	260	335	420	555
	5N-L	30	73	145	220	315	395	540
	AVE.	41	108	182	261	353	438	591
	MAX.	50	145	230	330	435	525	670
	MIN.	30	73	145	215	315	395	540

COMMENTS:

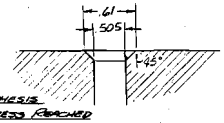
1. SOCKET HEAD OF BOLT 1-H RUPTURED BY TOOL AT 6TH POINT OF 3RD TORQUING.
2. " " " 1-H " " " 6TH " " 2ND "
3. BOLTS 3-H, 4-H, 5-H WERE TORQUED TO LEVELS BELOW THAT WHICH CAUSED HEAD RUPTURE BY TOOL UNTIL THE 5TH TORQUING.
4. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF EACH TORQUING FOR INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
5. SPACER BLOCKS WERE SANDED AT THE END OF THE 5TH TORQUING OF EACH SPECIMEN FOR THE DRY CONDITIONS ONLY DUE TO SCARRING.

Date — 28 March 1956
Size — E 1/2-20 UNF-3A
Screw or Bolt — MS 20008-50 MFTD by Aircraft Bolt Corp. El Monte, Cal.
Nut — EB-080 " " Elastic Stop Nut Corp, Union, N.J.

Test Cell — N9
Torsion — 7878
Compression — 58

Test Data
Contract N° AF 33(616)2808
P-1227

Note:
Figures in Parenthesis
Denote Tensile Stress Reached



Sketch Showing Head
Fillet Clearance In Hardened
Steel Spacing Block
(Rockwell "C" Scale 60)

E

Non Lubricated

Torqued From Head

Torquing N°	Specimen N°	Tensile Stress (#/in²) 10,000 Torque (in-#)	30,000 Torque (in-#)	50,000 Torque (in-#)	70,000 Torque (in-#)	90,000 Torque (in-#)	110,000 Torque (in-#)	Theoretical Yield Pt. 140,000 Torque (in-#)
Initial Torquing	1H	185	465	750	1155	1565	1690	
	2H	330	605	955	1300	1695	2085	
	3H	120	355	645	985	1350	1670	
	4H	225	515	805	1105	1430	1785	
	5H	205	475	785	1145	1500	1850	
	Ave.	213	483	788	1144	1466	1808	
	Max.	330	605	955	1300	1695	2645	
	Min.	120	355	645	985	1350	1670	
2nd Torquing	1H	398	870	1255	1630	1995	(1)(3)	
	2H	390	960	1370	1670	1995	2225 (1)	
	3H	350	895	1285	1680	1970	2265	
	4H	345	720	1270	1615	1950	(2)	
	5H	470	1065	1400	1825	2155	(2)	
	Ave.	391	898	1318	1686	2013	2245	
	Max.	470	1065	1400	1825	2155	2265	
	Min.	345	720	1255	1615	1950	2225	
3rd Torquing	1H	Socket head ruptured at end of 2nd. torquing						
	2H	"	"	"	"	"	"	
	3H	400	960	1350	1785	2095	(2)	
	4H	378	955	1380	1735	2075	(2)	
	5H	430	1070	1520	1880	Disc.	(2)	
	Ave.	403	995	1417	1800	2085		
	Max.	430	1070	1520	1880	2095		
	Min.	378	955	1350	1735	2075		
4th Torquing	1H							
	2H							
	3H	420	932	1345	1750	2080	(2)	
	4H	440	975	1375	1715	2060	(2)	
	5H	465	1050	1475	1825	Disc.	(2)	
	Ave.	442	986	1398	1763	2070		
	Max.	465	1050	1475	1825	2080		
	Min.	420	932	1345	1715	2060		
5th Torquing	1H							
	2H							
	3H	395	930	1355	1745	2075	(2)	
	4H	415	940	1340	1725	2090	(2)	
	5H	475	1035	1450	1775	Disc.	(2)	
	Ave.	428	968	1382	1748	2083		
	Max.	475	1035	1450	1775	2090		
	Min.	395	930	1340	1725	2075		

Torqued From Nut

Specimen N°	Tensile Stress (#/in²) 10,000 Torque (in-#)	30,000 Torque (in-#)	50,000 Torque (in-#)	70,000 Torque (in-#)	90,000 Torque (in-#)	110,000 Torque (in-#)	Theoretical Yield Pt. 140,000 Torque (in-#)
1N	95	425	720	960	1225	1480	
2N	290	680	1120	1515	1795	2115	
3N	280	555	880	1150	1900	1640	
4N	322	760	1190	1515	1845	2145	
5N	235	595	985	1330	1625	1985	
Ave.	234	603	969	1294	1578	1855	
Max.	322	760	1140	1515	1845	2145	
Min.	95	425	720	960	1225	1480	
1N	280	645	945	1270	1500	1672	
2N	452	935	1340	1725	2035	2250	
3N	500	950	1325	1585	1820	2050	
4N	460	1055	1500	1855	2160	2485	
5N	930	940	1325	1725	2030	2390	
Ave.	424	905	1287	1632	1909	2159	
Max.	500	1055	1500	1855	2160	2485	
Min.	280	645	945	1270	1500	1672	
1N	379	800	1100	1402	1635	1923	
2N	500	1005	1495	1855	2135	2380	
3N	525	1055	1490	1715	1975	2185	
4N	488	1173	1640	2025	2320	2650	
5N	435	1058	1530	1915	2230	2530	
Ave.	465	1017	1437	1782	2059	2334	
Max.	525	1173	1640	2025	2320	2650	
Min.	377	800	1100	1402	1635	1923	
1N	415	855	1235	1535	1825	2090	
2N	525	1095	1560	1930	2222	2535	
3N	728	1300	1625	1970	2115	2325	
4N	370	890	1550	1835	2300	2595	
5N	550	1085	1715	2100	2420	2700	
Ave.	517	1065	1499	1854	2176	2439	
Max.	725	1300	1715	2100	2420	2760	
Min.	370	855	1235	1535	1825	2040	
1N	405	923	1250	1615	1902	2200	2440
2N	555	1075	1560	1975	2285	2595	2875
3N	585	1115	1600	1995	2285	2480	2965
4N	515	1180	1695	2100	2425	2685	3085
5N	560	1155	1675	2100	2405	2685	3005
Ave.	524	1090	1556	1957	2260	2529	2878
Max.	585	1180	1695	2100	2425	2685	3085
Min.	405	923	1250	1615	1902	2200	2440

Lubricated

Torqued From Head

Specimen N°	Tensile Stress (#/in²) 10,000 Torque (in-#)	30,000 Torque (in-#)	50,000 Torque (in-#)	70,000 Torque (in-#)	90,000 Torque (in-#)	110,000 Torque (in-#)	Theoretical Yield Pt. 140,000 Torque (in-#)
1H-L	(80	205	332	475	625	790	
2H-L	60	165	272	405	520	645	
3H-L	60	160	275	425	580	750	
4H-L	70	175	275	385	525	655	
5H-L	105	200	305	430	575	715	
Ave.	75	181	292	424	565	711	
Max.	105	205	332	475	625	790	
Min.	60	160	272	385	520	645	
1H-L	90	235	380	550	720	870	
2H-L	75	190	300	410	525	640	
3H-L	120	250	370	477	600	720	
4H-L	85	215	310	415	530	670	
5H-L	80	215	315	420	532	650	
Ave.	90	221	335	454	581	710	
Max.	120	250	380	550	720	870	
Min.	75	190	300	410	525	640	
1H-L	140	305	480	625	755	895	
2H-L	75	190	295	430	535	665	
3H-L	75	195	320	430	545	665	
4H-L	75	195	280	405	520	625	
5H-L	110	270	352	460	570	690	
Ave.	95	223	345	470	585	708	
Max.	140	305	480	625	755	895	
Min.	75	170	280	405	520	625	
1H-L	140	330	470	610	725	875	
2H-L	90	215	330	445	565	695	
3H-L	85	285	395	470	575	695	
4H-L	95	205	322	430	550	652	
5H-L	115	270	385	500	615	735	
Ave.	103	249	370	491	606	730	
Max.	140	330	470	610	725	875	
Min.	85	205	322	430	550	652	
1H-L	140	350	475	605	765	890	1145
2H-L	100	225	345	450	595	740	955
3H-L	100	245	365	506	615	748	925
4H-L	95	225	320	960	590	705	880
5H-L	125	285	410	535	660	785	960
Ave.	112	266	383	511	645	774	997
Max.	140	350	475	605	765	890	1165
Min.	95	225	320	450	590	705	880

Torqued From Nut

Specimen N°	Tensile Stress (#/in²) 10,000 Torque (in-#)	30,000 Torque (in-#)	50,000 Torque (in-#)	70,000 Torque (in-#)	90,000 Torque (in-#)	110,000 Torque (in-#)	Theoretical Yield Pt. 140,000 Torque (in-#)
1H-L	65	170	285	408	580	800	
2H-L	65	155	275	395	577	785	
3H-L	85	210	325	435	610	800	
4H-L	75	195	295	425	560	750	
5H-L	75	170	280	350	510	678	
Ave.	73	180	292	403	567	761	
Max.	85	210	325	435	610	800	
Min.	65	155	275	350	510	678	
1H-L	78	172	290	400	540	720	
2H-L	95	200	300	445	610	785	
3H-L	75	170	270	365	490	665	
4H-L	85	150	235	360	505	640	
5H-L	60	125	215	315	455	610	
Ave.	79	163	260	377	520	684	
Max.	95	200	300	445	610	785	
Min.	60	125	215	315	455	610	
1H-L	77	175	285	415	535	710	
2H-L	50	130	228	345	485	630	
3H-L	95	215	305	410	550	690	
4H-L	102	200	280	420	575	710	
5H-L	90	180	275	370	500	640	
Ave.	83	180	275	392	529	676	
Max.	102	215	305	420	575	710	
Min.	50	130	228	345	485	630	
1H-L	95	178	305	425	555	785	
2H-L	90	210	325	435	580	735	
3H-L	65	160	270	395	505	607	
4H-L	75	148	230	355	520	660	
5H-L	65	188	222	320	420	525	
Ave.	74	165	270	386	516	650	
Max.	90	210	325	435	580	735	
Min.	65	128	222	320	420	525	
1H-L	90	200	330	455	600	765	1025
2H-L	65	130	235	357	470	572	880
3H-L	100	245	320	432	555	653	860
4H-L	100	195	285	425	560	710	975
5H-L	80	200	290	400	475	595	870
Ave.	87	194	292	414	532	655	922
Max.	100	245	330	455	600	765	1025
Min.	65	130	235	357	470	572	860

Comments:
1. Socket heads of bolts 1H & 2H (non-lubricated; torque from head) ruptured by the toequing tool at end of 2nd torquing. Tests had to be discontinued.
2. Non-lubricated head torqued bolts 5H thru 5H were torqued to values less than that which caused rupture of the socket type heads. Critical values of torque were between 2300 & 2300 in-lb.
3. Two 3/8" sockets, one standard & one heavy duty were cracked at high torque values required to torque bolt 1H.
4. Runs of lubricated torquings are marked with an "L" at the beginning of each torquing for initial lubrication and subsequent lubrications of nut or head bearing surfaces.
5. Spacer blocks were sanded at the end of the 5th torquing of each specimen for the dry conditions only due to scarring.

Page 1/4

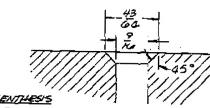
DATE — 25 FEBRUARY 1957
SIZE — F 9/16-18 UNF-3A
SCREW OR BOLT — MS 20,009-50 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — (3) EB-098 MFD. BY ELASTIC STOP NUT CORP., UNION, N. J.
(2) 92EW-918 " " FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN PA.
NUT FOR BOLT MARKED (A) FURNISHED BY LOCKHEED AIRCRAFT CORP., BURBANK, CAL.
" " " " (B) " " BOEING AIRPLANE CO., WITCHITA, KAN.

TEST CELL – Nº
TORSION – 7A
COMPRESSION – 5C

TEST DATA

CONTRACT Nº AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

F

NON LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1H	580	1400	2140	(64,000 PSI) 2640 ← HEAD SOCKET & HEX. WRENCH RUPTURED			
	2H	500	1180	2000 (1)				
	3H	400	880	1360 (1)				
	(A) 4H	300	820	1260 (1)				
	(B) 5H	360	760	1160 (1)				
	AVE.	428	1008	1584				
	MAX.	580	1400	2140				
	MIN.	300	760	1160				
2nd Torquing	1H	TEST DISCONTINUED						
	2H	1000	2040 (1)					
	3H	600	1400 (1)					
	(A) 4H	560	1160 (1)					
	(B) 5H	560	1200 (1)					
	AVE.	680	1450					
	MAX.	1000	2040					
	MIN.	560	1160					
3rd Torquing	1H							
	2H	1100	2240 (1)					
	3H	800	1640 (1)					
	(A) 4H	700	1340 (1)					
	(B) 5H	700	1360 (1)					
	AVE.	825	1645					
	MAX.	1100	2240					
	MIN.	700	1340					
4th Torquing	1H							
	2H	1220	2460 ← HEAD SOCKET RUPTURED DURING UNTORQUING					
	3H	860	1780 (1)					
	(A) 4H	660	1340 (1)					
	(B) 5H	720	1440 (1)					
	AVE.	865	1755					
	MAX.	1220	2460					
	MIN.	660	1340					
5th Torquing	1H							
	2H	TEST DISCONTINUED						
	3H	800	1760 (1)					
	(A) 4H	700	1420 (1)					
	(B) 5H	680	1460	2000	2460 ← HEAD SOCKET AND HEX. WRENCH RUPTURED			
	AVE.	727	1547	2000	2460			
	MAX.	800	1760	2000	2460			
	MIN.	680	1420	2000	2460			

NON LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); all values Torque (in-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1N	500	1200	1820	2400	3000	3640	
	2N	460	1200	2020	2860	3460	3940	
	3N	600	1360	2020	2580	3100	3620	
	(A) 4N	360	780	1080	1380	1800	2180	
	(B) 5N	220	540	880	1280	1700	2060	
	AVE.	428	1016	1564	2100	2612	3088	
	MAX.	600	1360	2020	2860	3460	3940	
	MIN.	220	540	880	1280	1700	2060	
2nd Torquing	1N	1180	2320	3000	3620	4040	4400	
	2N	740	1680	2420	3200	3780	4200	
	3N	780	1600	2180	2780	3360	3940	
	(A) 4N	540	1160	1640	2100	2540	2860	
	(B) 5N	400	980	1380	1840	2240	2540	
	AVE.	728	1548	2124	2708	3192	3588	
	MAX.	1180	2320	3000	3620	4040	4400	
	MIN.	400	980	1380	1840	2240	2540	
3rd Torquing	1N	980	1980	2800	3500	4100	4540	
	2N	880	1900	2740	3440	4060	4440	
	3N	880	1740	2400	3080	3600	4080	
	(A) 4N	700	1480	2100	2600	3060	3440	
	(B) 5N	500	1120	1660	2140	2560	2900	
	AVE.	788	1644	2340	2952	3476	3880	
	MAX.	980	1980	2800	3500	4100	4540	
	MIN.	500	1120	1660	2140	2560	2900	
4th Torquing	1N	960	2140	2940	3640	4300	4700	
	2N	1060	2040	2940	3720	4260	4560	
	3N	800	1680	2480	3040	3700	4200	
	(A) 4N	760	1700	2340	2920	3420	3900	
	(B) 5N	560	1400	1960	2460	2860	3200	
	AVE.	828	1792	2532	3156	3708	4112	
	MAX.	1060	2140	2940	3720	4300	4700	
	MIN.	560	1400	1960	2460	2860	3200	
5th Torquing	1N	980	2180	2980	3660	4300	4800	5060
	2N	1100	2060	2980	3780	4240	4640	5080
	3N	800	1860	2600	3200	3840	4360	5000
	(A) 4N	900	1960	2660	3300	3800	4300	4740
	(B) 5N	600	1400	2060	2560	3020	3440	3940
	AVE.	876	1892	2656	3300	3840	4308	4764
	MAX.	1100	2180	2980	3780	4300	4800	5080
	MIN.	600	1400	2060	2560	3020	3440	3940

LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1H-L	(3) L 140	320	540	760	1000	1260	
	2H-L	L 160	360	580	860	1100	1440	
	3H-L	L 160	300	480	660	960	1240	
	(A) 4H-L	L 140	280	440	600	860	1160	
	(B) 5H-L	L 140	320	540	820	1120	1500	
	AVE.	148	316	516	740	1008	1320	
	MAX.	160	360	580	860	1120	1500	
	MIN.	140	280	440	600	860	1160	
2nd Torquing	1H-L	L 140	320	420	740	980	1260	
	2H-L	L 140	340	540	760	1000	1280	
	3H-L	L 140	280	420	580	800	1080	
	(A) 4H-L	L 120	300	500	720	1040	1340	
	(B) 5H-L	L 200	340	560	780	1160	1480	
	AVE.	148	316	488	716	996	1288	
	MAX.	200	340	560	780	1160	1480	
	MIN.	140	280	420	580	800	1080	
3rd Torquing	1H-L	L 100	280	460	640	880	1120	
	2H-L	L 140	360	640	900	1120	1360	
	3H-L	L 100	300	500	740	1000	1100	
	(A) 4H-L	L 160	400	640	940	1100	1300	
	(B) 5H-L	L 180	360	540	700	1000	1300	
	AVE.	136	340	556	784	1020	1236	
	MAX.	180	400	640	940	1120	1360	
	MIN.	100	280	460	640	880	1100	
4th Torquing	1H-L	L 120	280	460	640	840	1060	
	2H-L	L 140	340	560	800	1080	1360	
	3H-L	L 100	300	500	740	1000	1200	
	(A) 4H-L	L 140	360	600	860	1040	1200	
	(B) 5H-L	L 160	360	600	820	1120	1300	
	AVE.	132	328	544	772	1016	1224	
	MAX.	160	360	600	860	1120	1360	
	MIN.	100	280	460	640	840	1060	
5th Torquing	1H-L	L 100	260	440	600	760	900	1240
	2H-L	L 100	280	540	760	920	1060	1360
	3H-L	L 120	340	540	800	1000	1160	1500
	(A) 4H-L	L 140	340	600	800	980	1140	1400
	(B) 5H-L	L 160	360	580	800	1000	1240	1560
	AVE.	124	316	540	752	932	1100	1412
	MAX.	160	360	600	800	1000	1240	1560
	MIN.	100	260	440	600	760	900	1240

LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); all values Torque (in-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1N-L	(3) L 100	200	340	520	740	1060	
	2N-L	L 100	240	380	600	900	1160	
	3N-L	L 100	240	440	680	840	1200	
	(A) 4N-L	L 160	320	520	760	980	1200	
	(B) 5N-L	L 160	320	540	760	1000	1280	
	AVE.	124	264	444	664	892	1180	
	MAX.	160	320	540	760	1000	1280	
	MIN.	100	200	340	520	740	1060	
2nd Torquing	1N-L	140	360	580	800	1080	1360	
	2N-L	L 80	180	360	600	860	1140	
	3N-L	L 100	240	440	700	960	1240	
	(A) 4N-L	L 140	380	500	700	960	1200	
	(B) 5N-L	L 120	300	520	720	920	1160	
	AVE.	116	292	480	704	956	1220	
	MAX.	140	380	580	800	1080	1360	
	MIN.	80	180	360	600	860	1140	
3rd Torquing	1N-L	L 80	200	380	580	760	1000	
	2N-L	L 100	240	440	700	940	1200	
	3N-L	L 140	300	540	780	1060	1360	
	(A) 4N-L	L 120	300	520	740	1000	1240	
	(B) 5N-L	L 120	280	480	680	880	1080	
	AVE.	112	264	472	696	928	1176	
	MAX.	140	300	540	780	1060	1360	
	MIN.	80	200	380	580	760	1000	
4th Torquing	1N-L	L 120	240	460	700	940	1200	
	2N-L	L 80	200	400	660	880	1080	
	3N-L	L 120	300	540	700	1040	1280	
	(A) 4N-L	L 120	300	540	760	1000	1220	
	(B) 5N-L	L 100	240	460	640	840	1040	
	AVE.	108	256	480	692	940	1164	
	MAX.	120	300	540	760	1040	1280	
	MIN.	80	200	400	640	840	1040	
5th Torquing	1N-L	L 80	240	440	660	900	1140	1500
	2N-L	L 60	180	360	600	800	1040	1400
	3N-L	L 140	320	560	780	1000	1240	1600
	(A) 4N-L	L 100	260	520	760	1000	1260	1540
	(B) 5N-L	L 100	220	400	600	820	1060	1380
	AVE.	96	244	456	680	904	1148	1484
	MAX.	140	320	560	780	1000	1260	1600
	MIN.	60	180	360	600	800	1040	1380

COMMENTS:
(1) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE TORQUED TO 30,000 OR 50,000 PSI ONLY TO PREVENT RUPTURE OF THE BOLT HEAD SOCKET & HEX. WRENCH AT VALUES OF TORQUE ABOVE 2000 IN-LB.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

PAGE 1B

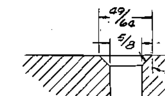
TEST CELL — No.
TORSION — 6B & 7A
COMPRESSION — 5C

DATE — 4 FEBRUARY 1957
SIZE — G 5/8-18 UNF-3A
SCREW OR BOLT — MS-20010-50 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — 3-EB-108 MFD. BY ELASTIC STOP NUT CORP., UNION, N.J.
2-42 FW-1018 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.
(NUT FOR BOLT MARKED (A) FURNISHED BY LOCKHEED AIRCRAFT CORP., BURBANK, CAL.)
(" " " " (B) " " BOEING AIRPLANE CO., WICHITA, KAN.)

TEST DATA

CONTRACT No. AF 33(616)2808
F-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C"-SCALE 60)

WADC TR 57-330

G

NON LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1H	420	940	1480	2160	2900	3700	
	2H	400	1020	1700	2480	3260 ← HEX. HEAD & TOOL RUPT.		
	3H	560	1360	2240 (1)				
	(A) 4H	660	1260	1800 (1)				
	(B) 5H	640	1160	1560 (1)				
	AVE.	536	1148	1756	2320	3080	3700	
	MAX.	640	1360	2240	2480	3260	3700	
	MIN.	400	940	1480	2160	2900	3700	
2nd Torquing	1H	RECESSED HEX. HEAD & TOOL RUPTURED AT END OF 1ST TORQUING - TEST DISCONTINUED						
	2H	TEST DISCONTINUED						
	3H	1000	2000	2800 (1)				
	(A) 4H	1100	1800	2400 (1)				
	(B) 5H	1060	1780	2280 (1)				
	AVE.	1053	1860	2493				
	MAX.	1100	2000	2800				
	MIN.	1000	1780	2280				
3rd Torquing	1H							
	2H							
	3H	1000	2220	3100 (1)				
	(A) 4H	1220	2200	2860 (1)				
	(B) 5H	1300	2080	2640 (1)				
	AVE.	1173	2167	2867				
	MAX.	1300	2220	3100				
	MIN.	1000	2080	2640				
4th Torquing	1H							
	2H							
	3H	1160	2360	3060 (1)				
	(A) 4H	1460	2400	3120 (1)				
	(B) 5H	1460	2400	3000 (1)				
	AVE.	1360	2387	3060				
	MAX.	1460	2400	3120				
	MIN.	1160	2360	3000				
5th Torquing	1H							
	2H							
	3H	1140	2300	2980 (1)				
	(A) 4H	1420	2400	3020 (1)				
	(B) 5H	1460	2400	3060	(62,500 PSI) 3500 ← 70,000 PSI NOT ATTEMPTED DUE TO INDICATIONS OF BOLT HEAD RUPTURE			
	AVE.	1340	2367	3020				
	MAX.	1460	2400	3060				
	MIN.	1140	2300	2980				

NON LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1N	300	860	1660	2500	3300	3900	
	2N	560	1380	2340	3340	4200	4940	
	3N	520	1340	2320	3300	3900	4400	
	(A) 4N	200	540	900	1240	1600	1940	
	(B) 5N	260	440	660	1000	1380	1840	
	AVE.	368	912	1576	2276	2876	3404	
	MAX.	560	1380	2340	3340	4200	4940	
	MIN.	200	440	660	1000	1380	1840	
2nd Torquing	1N	520	1400	2280	3160	4040	4760	
	2N	640	1480	2300	3180	3900	4520	
	3N	640	1760	2780	3560	4200	4800	
	(A) 4N	360	800	1200	1640	2020	2420	
	(B) 5N	280	600	1000	1420	1900	2360	
	AVE.	488	1208	1912	2592	3212	3772	
	MAX.	640	1760	2780	3560	4200	4800	
	MIN.	280	600	1000	1420	1900	2360	
3rd Torquing	1N	600	1460	2400	3420	4280	4960	
	2N	600	1400	2200	3040	3900	4640	
	3N	760	1800	2800	3680	4400	5000	
	(A) 4N	220	560	960	1420	1900	2400	
	(B) 5N	400	800	1200	1700	2160	2660	
	AVE.	516	1204	1912	2652	3328	3932	
	MAX.	760	1800	2800	3680	4400	5000	
	MIN.	220	560	960	1420	1900	2400	
4th Torquing	1N	640	1600	2520	3460	4300	5000	
	2N	560	1400	2220	3180	4000	4720	
	3N	700	1740	2800	3700	4500	5020	
	(A) 4N	400	940	1480	2080	2600	3100	
	(B) 5N	400	900	1360	1980	2360	2840	
	AVE.	540	1316	2076	2880	3552	4136	
	MAX.	700	1740	2800	3700	4500	5020	
	MIN.	400	900	1360	1980	2360	2840	
5th Torquing	1N	700	1760	2700	3660	4440	5140	5940
	2N	560	1360	2180	3020	3820	4600	5380
	3N	700	1700	2760	3700	4400	5100	5780
	(A) 4N	500	1100	1700	2380	3000	3460	4140
	(B) 5N	460	1000	1500	2020	2540	3060	3780
	AVE.	584	1384	2168	2956	3640	4272	5004
	MAX.	700	1760	2760	3700	4440	5140	5940
	MIN.	460	1000	1500	2020	2540	3060	3780

LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1H-L	(2) L 120	260	500	800	1100	1500	
	2H-L	L 240	420	680	1000	1300	1600	
	3H-L	L 200	440	720	1060	1460	1900	
	(A) 4H-L	L 220	440	700	1020	1400	1860	
	(B) 5H-L	L 240	500	800	1160	1500	1860	
	AVE.	204	412	680	1008	1352	1744	
	MAX.	240	500	800	1160	1500	1900	
	MIN.	120	260	500	800	1100	1500	
2nd Torquing	1H-L	L 120	280	500	720	1020	1300	
	2H-L	L 240	500	740	1060	1360	1600	
	3H-L	L 180	420	660	940	1280	1560	
	(A) 4H-L	L 340	620	920	1200	1440	1660	
	(B) 5H-L	L 300	460	700	1000	1260	1580	
	AVE.	236	456	704	984	1272	1540	
	MAX.	340	620	920	1200	1440	1660	
	MIN.	120	280	500	720	1020	1300	
3rd Torquing	1H-L	L 140	300	520	800	1020	1360	
	2H-L	L 220	500	740	1000	1300	1580	
	3H-L	L 180	400	640	860	1100	1400	
	(A) 4H-L	L 400	720	1020	1300	1560	1860	
	(B) 5H-L	L 240	460	700	960	1260	1600	
	AVE.	236	476	724	984	1248	1560	
	MAX.	400	720	1020	1300	1560	1860	
	MIN.	140	300	520	800	1020	1360	
4th Torquing	1H-L	L 140	300	540	800	1040	1360	
	2H-L	L 140	420	700	1020	1340	1660	
	3H-L	L 200	440	680	980	780	1600	
	(A) 4H-L	L 300	600	880	1160	1400	1700	
	(B) 5H-L	L 200	420	660	980	1280	1600	
	AVE.	196	436	692	988	1168	1584	
	MAX.	300	600	880	1160	1400	1700	
	MIN.	140	300	540	800	780	1360	
5th Torquing	1H-L	L 220	460	700	960	1240	1560	2080
	2H-L	L 200	420	660	960	1300	1700	2200
	3H-L	L 180	420	700	1020	1300	1560	2160
	(A) 4H-L	L 300	620	900	1200	1500	1860	2400
	(B) 5H-L	L 200	420	700	980	1300	1640	2140
	AVE.	220	468	732	1024	1328	1664	2196
	MAX.	300	620	900	1200	1500	1860	2400
	MIN.	180	420	660	960	1240	1560	2080

LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1N-L	(2) 120	260	460	720	1000	1300	
	2N-L	L 140	280	460	700	960	1260	
	3N-L	L 140	300	500	760	1060	1400	
	(A) 4N-L	L 140	360	600	900	1200	1560	
	(B) 5N-L	L 200	360	620	1000	1360	1700	
	AVE.	148	312	528	816	1116	1444	
	MAX.	200	360	620	1000	1360	1700	
	MIN.	120	260	460	700	960	1260	
2nd Torquing	1N-L	L 80	200	420	720	1120	1300	
	2N-L	L 120	260	440	780	1060	1300	
	3N-L	L 100	260	500	820	1100	1420	
	(A) 4N-L	L 120	300	540	840	1160	1500	
	(B) 5N-L	L 100	240	460	760	1000	1260	
	AVE.	104	252	472	784	1088	1356	
	MAX.	120	300	540	840	1160	1500	
	MIN.	80	200	420	720	1000	1300	
3rd Torquing	1N-L	L 80	200	400	700	980	1260	
	2N-L	L 80	200	440	740	1020	1320	
	3N-L	L 100	240	500	800	1040	1360	
	(A) 4N-L	L 140	340	600	960	1260	1560	
	(B) 5N-L	L 100	240	500	760	1060	1400	
	AVE.	100	244	488	792	1072	1380	
	MAX.	140	340	600	960	1260	1560	
	MIN.	80	200	400	700	980	1260	
4th Torquing	1N-L	L 60	180	400	700	980	1300	
	2N-L	L 80	220	460	800	1120	1400	
	3N-L	L 120	240	500	840	1000	1260	
	(A) 4N-L	L 100	320	600	900	1260	1620	
	(B) 5N-L	L 100	300	560	860	1120	1400	
	AVE.	92	252	504	820	1096	1396	
	MAX.	120	320	600	900	1260	1620	
	MIN.	60	180	400	700	980	1260	
5th Torquing	1N-L	L 60	140	300	580	860	1100	1520
	2N-L	L 80	160	360	660	1000	1300	1800
	3N-L	L 80	260	500	800	1100	1400	1800
	(A) 4N-L	L 100	260	500	860	1160	1500	1960
	(B) 5N-L	L 100	300	540	800	1100	1380	1900
	AVE.	84	224	440	740	1044	1336	1796
	MAX.	100	300	540	860	1160	1500	1960
	MIN.	60	140	300	580	860	1100	1520

COMMENTS:
(1) SPECIMENS 3H TO 5H WERE TORQUED TO VALUES LESS THAN THOSE CAUSING RUPTURE OF THE RECESSED HEX. HEAD AND DRIVING TOOL.
(2) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(3) SPACER BLOCKS WERE SANDED AFTER EACH SPECIMEN RUN FOR BOTH DRY & LUBRICATED CONDITIONS DUE TO SCARRING.

DATE — 13 FEBRUARY, 1957
SIZE — H, 5/16-16 UNF-3A
SCREW OR BOLT — MS 20012-50 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — 3-EB-126 MFD. BY ELASTIC STOP NUT CORP., UNION, N.J.; 2-22 FW-1218 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.
(NUT FOR BOLT MARKED (A) FURNISHED BY LOCKHEED AIRCRAFT CORP., BURBANK, CAL.; (B) " " BOEING AIRPLANE CO., WICHITA, KAN.)

TEST CELL — Nº
TORSION — 6B87A
COMPRESSION — 5C

TEST DATA

CONTRACT Nº AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED

SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

5/64 — 3/4 — 45°

H

NON LUBRICATED

TORQUED FROM HEAD

TORQUING Nº	SPECIMEN Nº	10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	110,000 TORQUE (IN.-#)	THEORETICAL YIELD POINT 140,000 TORQUE (IN.-#)
INITIAL TORQUING	1H	1080	2540	3960	5480	6880	TEST HEAD RUPTURED	
	2H	980	2500	4000 (1)				
	3H	620	1740	3040 (1)				
	(A)4H	560	1260	2180 (1)				
	(B)5H	900	2100	3200 (1)				
	AVE.	828	2028	3276				
	MAX.	1080	2540	4000				
	MIN.	560	1260	2180				
2ND TORQUING	1H	TEST	DIS	CONTINUED				
	2H	1500	3280	4700 (1)				
	3H	1100	2360	3460 (1)				
	(A)4H	1000	2200	3100 (1)				
	(B)5H	1160	2460	3680 (1)				
	AVE.	1190	2575	3735				
	MAX.	1500	3280	4700				
	MIN.	1000	2200	3100				
3RD TORQUING	1H							
	2H	1540	3440	4860 (1)				
	3H	1040	2620	3700 (1)				
	(A)4H	1240	2460	3560 (1)				
	(B)5H	1400	2840	4080 (1)				
	AVE.	1305	2840	4050				
	MAX.	1540	3440	4860				
	MIN.	1040	2460	3560				
4TH TORQUING	1H							
	2H	1560	3520	4840 (1)				
	3H	1200	2620	3720 (1)				
	(A)4H	1560	3060	4260 (1)				
	(B)5H	1660	3100	4380 (1)				
	AVE.	1495	3075	4300				
	MAX.	1660	3520	4840				
	MIN.	1200	2620	3720				
5TH TORQUING	1H							TESTS DISCONTINUED WHEN BOLT HEAD AND/OR TOOL SHOWED SIGNS OF RUPTURE
	2H	1600	3400	4700	6020	(1)		←
	3H	1180	2400	3500	4240	4900	5660 (1)	←
	(A)4H	1540	3000	4160	4940	5720	(1)	←
	(B)5H	1700	3220	4440	5480	(87,200 PSI) 6500	(1)	←
	AVE.	1502	3005	4200	5170	5310	5660	
	MAX.	1700	3400	4700	6020	5720	5660	
	MIN.	1180	2400	3500	4240	4900	5660	

TORQUED FROM NUT

TORQUING Nº	SPECIMEN Nº	10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	110,000 TORQUE (IN.-#)	THEORETICAL YIELD POINT 140,000 TORQUE (IN.-#)
INITIAL TORQUING	1N	1240	3100	4600	5940	7400	8800	
	2N	860	2160	3840	5260	6820	8180	
	3N	860	2580	3940	5100	6040	6800	
	(A)4N	1100	2600	3900	5200	6400	7200	
	(B)5N	500	1040	1760	2260	2840	3460	
	AVE.	912	2296	3608	4752	5900	6888	
	MAX.	1240	3100	4600	5940	7400	8800	
	MIN.	500	1040	1760	2260	2840	3460	
2ND TORQUING	1N	1880	3840	5380	6600	7740	8840	
	2N	1400	3060	4600	5880	7060	8260	
	3N	1560	3200	4420	5460	6600	7600	
	(A)4N	1540	3240	4620	5860	6960	7960	
	(B)5N	700	1520	2240	2940	3660	4400	
	AVE.	1416	2972	4252	5348	6404	7412	
	MAX.	1880	3840	5380	6600	7740	8840	
	MIN.	700	1520	2240	2940	3660	4400	
3RD TORQUING	1N	1960	3760	5280	6700	7840	9000	
	2N	1560	3400	4860	6260	7560	8700	
	3N	1700	3700	5200	6440	7680	8780	
	(A)4N	1660	3200	4700	6080	7280	8300	
	(B)5N	1100	2300	3100	3860	4600	5280	
	AVE.	1596	3272	4628	5868	6992	8012	
	MAX.	1960	3760	5280	6700	7840	9000	
	MIN.	1100	2300	3100	3860	4600	5280	
4TH TORQUING	1N	2080	4240	5960	7500	8740	9900	
	2N	1600	3520	5260	6660	8040	9300	
	3N	2080	4440	6020	7320	8640	9740	
	(A)4N	1860	3560	5100	6620	8160	9140	
	(B)5N	1400	2800	3640	4420	5300	5900	
	AVE.	1804	3712	5196	6506	7776	8796	
	MAX.	2080	4440	6020	7500	8740	9900	
	MIN.	1400	2800	3640	4420	5300	5900	
5TH TORQUING	1N	2160	4500	6200	7740	9100	10260	11440
	2N	1700	3740	5580	7120	8400	9680	11260
	3N	2140	4300	5900	7120	8300	9400	10980
	(A)4N	2000	3860	5540	7220	8840	9800	(133,100 PSI) 10840 ← BOLT YIELDED
	(B)5N	1400	2900	3800	4600	5060	6400	7020
	AVE.	1880	3860	5404	6760	7940	9108	10175
	MAX.	2160	4500	6200	7740	9100	10260	11440
	MIN.	1400	2900	3800	4600	5060	6400	7020

LUBRICATED

TORQUED FROM HEAD

TORQUING Nº	SPECIMEN Nº	10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	110,000 TORQUE (IN.-#)	THEORETICAL YIELD POINT 140,000 TORQUE (IN.-#)
INITIAL TORQUING	1H-L	(3) L 400	1100	1740	2400	2980	3820	
	2H-L	L 300	760	1480	2280	3000	3740	
	3H-L	L 340	860	1400	2040	2740	3460	
	(A)4H-L	L 420	920	1580	2240	2880	3560	
	(B)5H-L	L 480	900	1460	2060	2740	3400	
	AVE.	388	908	1532	2204	2868	3596	
	MAX.	480	1100	1740	2400	3000	3820	
	MIN.	300	760	1400	2040	2740	3400	
2ND TORQUING	1H-L	L 360	920	1480	2340	3060	3860	
	2H-L	L 340	900	1400	2220	3220	3980	
	3H-L	L 300	800	1420	2300	3140	3800	
	(A)4H-L	L 320	800	1400	2000	2760	3560	
	(B)5H-L	L 480	900	1340	1900	2500	3000	
	AVE.	360	864	1408	2152	2936	3640	
	MAX.	480	920	1480	2340	3220	3980	
	MIN.	300	800	1340	1900	2500	3000	
3RD TORQUING	1H-L	L 260	760	1460	2200	2980	3640	
	2H-L	L 360	980	1700	2560	3420	4180	
	3H-L	L 280	820	1380	1980	2680	3400	
	(A)4H-L	L 280	760	1300	1860	2480	3300	
	(B)5H-L	L 460	1020	1540	2040	2540	3100	
	AVE.	328	868	1476	2128	2820	3524	
	MAX.	460	1020	1700	2560	3420	4180	
	MIN.	260	760	1300	1860	2480	3100	
4TH TORQUING	1H-L	L 280	980	1760	2460	3300	4000	
	2H-L	L 300	940	1540	2280	3260	4240	
	3H-L	L 320	860	1500	2180	2740	3360	
	(A)4H-L	L 380	900	1600	2260	3000	3740	
	(B)5H-L	L 460	980	1520	2300	3000	3600	
	AVE.	348	932	1584	2296	3060	3788	
	MAX.	460	980	1760	2460	3300	4240	BOLT YIELDED
	MIN.	280	860	1500	2180	2740	3360	
5TH TORQUING	1H-L	L 300	780	1260	2000	2880	3740	(135,200 PSI) 5400
	2H-L	L 320	860	1460	2160	2880	3720	(135,200 PSI) 6080
	3H-L	L 240	660	1260	1860	2540	3360	4600
	(A)4H-L	L 340	860	1600	2240	2960	3740	5020
	(B)5H-L	L 380	840	1380	2000	2660	3360	4520
	AVE.	316	800	1392	2052	2784	3584	4713
	MAX.	380	860	1600	2240	2960	3740	5020
	MIN.	240	660	1260	1860	2540	3360	4520

TORQUED FROM NUT

TORQUING Nº	SPECIMEN Nº	10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	110,000 TORQUE (IN.-#)	THEORETICAL YIELD POINT 140,000 TORQUE (IN.-#)
INITIAL TORQUING	1N-L	(3) L 240	660	1200	1780	2400	2980	
	2N-L	L 280	700	1300	2000	2740	3500	
	3N-L	L 300	1160	1740	2340	2840	3400	
	(A)4N-L	L 400	740	1320	2080	2880	3860	
	(B)5N-L	L 300	800	1460	2060	2660	3300	
	AVE.	304	812	1404	2052	2704	3408	
	MAX.	400	1160	1740	2340	2880	3860	
	MIN.	240	660	1200	1780	2400	2980	
2ND TORQUING	1N-L	L 200	560	1060	1600	2160	2640	
	2N-L	L 200	660	1340	1980	2740	3600	
	3N-L	L 320	860	1460	2020	2540	3060	
	(A)4N-L	L 500	1080	1820	2600	3400	4000	
	(B)5N-L	L 200	740	1320	1940	2540	3080	
	AVE.	284	780	1400	2028	2676	3276	
	MAX.	500	1080	1820	2600	3400	4000	
	MIN.	200	560	1060	1600	2160	2640	
3RD TORQUING	1N-L	L 220	600	1200	1700	2240	2700	
	2N-L	L 360	1100	1680	2340	3000	3800	
	3N-L	L 340	940	1520	2100	2640	3100	
	(A)4N-L	L 500	900	1600	2180	2720	3240	
	(B)5N-L	L 460	1000	1500	2000	2540	3180	
	AVE.	376	908	1500	2064	2628	3204	
	MAX.	500	1100	1680	2340	3000	3800	
	MIN.	220	600	1200	1700	2240	2700	
4TH TORQUING	1N-L	L 240	660	1240	1820	2300	2740	
	2N-L	L 200	560	1100	1700	2260	2800	
	3N-L	L 240	700	1280	1860	2400	2880	
	(A)4N-L	L 580	1080	1700	2440	3120	3700	
	(B)5N-L	L 260	780	1300	1900	2500	3020	
	AVE.	304	756	1324	1944	2516	3028	
	MAX.	580	1080	1700	2440	3120	3700	
	MIN.	200	560	1100	1700	2260	2740	
5TH TORQUING	1N-L	L 200	500	1060	1600	2200	2600	3440
	2N-L	L 180	520	1100	1660	2200	2660	3420
	3N-L	L 260	740	1280	2000	2500	2940	3860
	(A)4N-L	L 400	900	1620	2500	3120	3720	4540
	(B)5N-L	L 260	800	1300	1880	2500	2960	3860
	AVE.	260	692	1272	1928	2504	2976	3824
	MAX.	400	900	1620	2500	3120	3720	4540
	MIN.	180	500	1060	1600	2200	2600	3420

COMMENTS:
(1) SPECIMENS 2H TO 5H WERE TORQUED TO VALUES LESS THAN THOSE CAUSING RUPTURE OF THE RECESSED HEX. HEAD AND DRIVING TOOL.
(2) SPACER BLOCKS WERE SANDED AFTER EACH SPECIMEN RUN FOR THE LUBRICATED CONDITIONS AS WELL AS DRY DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

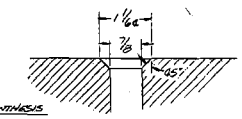
PAGE 4A

DATE — 21 FEBRUARY 1957
SIZE — 1, 3/8-18 UNF-3A
SCREW OR BOLT — MS 20014-50 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — 3-EB-144 MFD. BY ELASTIC STOP NUT CORP., UNION, N.J.
2-02 EW-1414 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.
(NUT FOR BOLT MARKED (A) FURNISHED BY LOCKHEED AIRCRAFT CORP., BURBANK, CAL.) 2

TEST CELL — No.
TORSION — 6B
COMPRESSION — 5C

TEST DATA
CONTRACT No. AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL C-SCALE 60)

I

NON LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	110,000 TORQUE (in-#)	THEORETICAL YIELD POINT 140,000 TORQUE (in-#)
INITIAL TORQUING No.							
1H	1560	4080	7000	(63,300 PSI) 8460 AND TOOL BROKE IN SHEAR.	RECESSED HEAD RUPTURED.		
2H	1500	4200	(1)				
3H	1200	3180	(1)				
(A)4H	1100	2700	5040	(1)			
(A)5H	1260	3000	5400	(1)			
AVE.	1324	3432	5819				
MAX.	1560	4200	7000				
MIN.	1100	2700	5040				
2ND TORQUING							
1H	2900	7800	(1)				
2H	2240	5060	(1)				
3H	1960	4100	(1)				
(A)4H	1600	3880	6200	(1)			
(A)5H	1760	4000	6600				
AVE.	2092	4968	6400				
MAX.	2900	7800	6600				
MIN.	1600	3880	6200				
3RD TORQUING							
1H	3160	8460	(1)				
2H	2440	6260	(1)				
3H	2260	4760	(1)				
(A)4H	1800	4320	6740	(1)			
(A)5H	1940	4540	7480	(1)			
AVE.	2320	5668	7110				
MAX.	3160	8460	7480				
MIN.	1800	4320	6740				
4TH TORQUING							
1H	3300	8320	(1)				
2H	2680	6300	(1)				
3H	2400	5200	(1)				
(A)4H	2000	4660	7100	(1)			
(A)5H	2200	5000	7940	(1)			
AVE.	2516	5896	7520				
MAX.	3300	8320	7940				
MIN.	2000	4660	7100				
5TH TORQUING							
1H	3420	(8,300 PSI) 8400	30,900 PSI POINT NOT ATTEMPTED DUE TO SIGNS OF RECESSED HEAD RUPTURE BY TOOL				
2H	2660	6300	(1)				
3H	2600	5600	(1)				
(A)4H	2060	4860	7300	(1)			
(A)5H	2300	5200	8400	(1)			
AVE.	2608	6072	7850				
MAX.	3420	8400	8400				
MIN.	2060	4860	7800				

TORQUED FROM NUT

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	110,000 TORQUE (in-#)	THEORETICAL YIELD POINT 140,000 TORQUE (in-#)
1N	1560	4920	7700	9900	11980	14060	
2N	1260	2900	4580	6260	7900	9200	
3N	1840	4920	7720	10000	12200	14180	
(A) 4N	1220	2500	4200	5620	7300	8900	
(A) 5N	720	1480	2400	3380	4500	5760	
AVE.	1320	3344	5320	7032	8776	10420	
MAX.	1840	4920	7720	10000	12200	14180	
MIN.	720	1480	2400	3380	4500	5760	
1N	2640	6600	9400	11460	13540	15240	
2N	2000	4760	7200	8540	10400	11500	
3N	3466	7600	10140	12360	14140	16660	
(A) 4N	2200	5060	6980	8760	10560	12160	
(A) 5N	1240	2780	4000	5300	6560	8000	
AVE.	2309	5360	7544	9284	11040	12712	
MAX.	3466	7600	10140	12360	14140	16660	
MIN.	1240	2280	4000	5300	6560	8000	
1N	2800	6800	9760	12140	14300	15960	
2N	3660	8240	11040	13060	14860	16340	
3N	3400	7360	10200	12440	14160	15800	
(A) 4N	2640	6580	9060	10900	12740	14360	
(A) 5N	2200	4160	6040	7720	9640	11340	
AVE.	2940	6628	9228	11252	13140	14760	
MAX.	3660	8240	11040	13060	14860	16340	
MIN.	2200	4160	6040	7720	9640	11340	
1N	2840	6960	10000	12400	14600	16260	
2N	3360	7440	10400	13120	15480	17560	
3N	3400	7720	10040	12160	14040	15740	
(A) 4N	3060	7060	9600	11860	13400	14980	
(A) 5N	2600	5500	7640	10000	12040	14000	
AVE.	3052	6936	9536	11908	13912	15700	
MAX.	3400	7720	10400	13120	15480	17560	
MIN.	2600	5500	7640	10000	12040	14000	
1N	2900	7300	10460	13200	15500	17500	18220
2N	3500	7600	10480	12780	14680	16500	18120
3N	3700	7280	9900	12160	14040	15660	17500
(A) 4N	2640	6540	9540	11940	13860	15760	17460
(A) 5N	2680	5560	8200	10600	12600	14500	17660
AVE.	3084	6886	9716	12136	14136	15984	17794
MAX.	3700	7600	10480	13200	15500	17500	18220
MIN.	2640	5560	8200	10600	12600	14500	17460

LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	110,000 TORQUE (in-#)	THEORETICAL YIELD POINT 140,000 TORQUE (in-#)
1H-L	340	840	1440	2020	2820	3700	
2H-L	420	980	1480	2000	2620	3200	
3H-L	380	900	1380	1980	2700	3440	
(A)4H-L	600	1140	1700	2360	3040	3880	
(A)5H-L	560	1000	1600	2400	3400	4640	
AVE.	440	972	1520	2164	2916	3772	
MAX.	600	1140	1700	2400	3400	4640	
MIN.	340	840	1380	1980	2620	3200	
1H-L	260	720	1260	1880	2600	3500	
2H-L	260	720	1300	1980	2740	3560	
3H-L	300	800	1300	1980	2800	3700	
(A)4H-L	400	900	1500	2240	3180	4080	
(A)5H-L	320	760	1400	2120	2840	3600	
AVE.	308	780	1352	2040	2832	3688	
MAX.	400	900	1500	2240	3180	4080	
MIN.	260	720	1260	1880	2600	3500	
1H-L	220	720	1400	2100	2800	3600	
2H-L	240	800	1360	2060	2840	3600	
3H-L	260	800	1460	2100	2800	3420	
(A)4H-L	380	900	1560	2200	2960	3800	
(A)5H-L	320	800	1500	2200	2960	3880	
AVE.	284	804	1456	2132	2872	3660	
MAX.	380	900	1560	2200	2960	3880	
MIN.	220	720	1360	2060	2800	3420	
1H-L	220	780	1460	2160	2880	3600	
2H-L	260	780	1480	2320	3200	3900	
3H-L	300	800	1480	2120	2840	3500	
(A)4H-L	400	1000	1660	2380	3120	4000	
(A)5H-L	340	800	1500	2200	2900	3620	
AVE.	304	832	1516	2236	2988	3724	
MAX.	400	1000	1660	2380	3200	4000	
MIN.	220	780	1460	2120	2840	3500	
1H-L	240	880	1600	2340	3000	3640	4860
2H-L	240	800	1540	2300	3120	4020	5240
3H-L	280	780	1500	2280	2800	3840	5200
(A)4H-L	400	1000	1740	2400	3200	4060	5460
(A)5H-L	360	900	1660	2380	3140	3980	5700
AVE.	304	872	1608	2340	3052	3908	5292
MAX.	400	1000	1740	2400	3200	4060	5700
MIN.	240	780	1500	2280	3000	3640	4860

TORQUED FROM NUT

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	110,000 TORQUE (in-#)	THEORETICAL YIELD POINT 140,000 TORQUE (in-#)
1N-L	400	900	1600	2300	3100	3900	
2N-L	340	800	1460	2040	2700	3440	
3N-L	280	700	1220	1780	2300	2980	
(A) 4N-L	400	940	1520	2200	3120	4000	
(A) 5N-L	400	940	1640	2380	3200	4200	
AVE.	364	856	1488	2140	2884	3704	
MAX.	400	940	1640	2380	3200	4200	
MIN.	280	700	1220	1780	2300	2980	
1N-L	440	1100	1860	2600	3360	4200	
2N-L	300	740	1400	2100	2800	3600	
3N-L	240	680	1200	1800	2420	3120	
(A) 4N-L	320	880	1480	2220	3100	4100	
(A) 5N-L	300	800	1380	2040	2700	3560	
AVE.	320	840	1464	2152	2876	3716	
MAX.	440	1100	1860	2600	3360	4200	
MIN.	240	680	1200	1800	2420	3120	
1N-L	300	1000	1760	2500	3200	3920	
2N-L	280	800	1420	2160	2900	3660	
3N-L	200	700	1400	2020	2640	3300	
(A) 4N-L	360	900	1540	2340	3200	4040	
(A) 5N-L	280	840	1500	2260	3020	3840	
AVE.	284	848	1524	2256	2992	3752	
MAX.	360	1000	1760	2500	3300	4040	
MIN.	200	700	1400	2020	2640	3300	
1N-L	300	940	1600	2400	3180	3960	
2N-L	280	800	1460	2220	3000	3720	
3N-L	260	800	1500	2100	2700	3320	
(A) 4N-L	380	940	1660	2440	3300	4160	
(A) 5N-L	340	980	1820	2600	3460	4340	
AVE.	312	892	1608	2352	3128	3900	
MAX.	380	980	1820	2600	3460	4340	
MIN.	260	800	1460	2100	2700	3320	
1N-L	300	940	1600	2460	3300	4160	5500
2N-L	280	800	1460	2120	2800	3540	4660
3N-L	260	760	1460	2140	2740	3400	4800
(A) 4N-L	400	1000	1780	2760	3620	4560	5700
(A) 5N-L	300	1000	1860	2660	3500	4360	5700
AVE.	308	900	1632	2428	3192	4004	5272
MAX.	400	1000	1860	2760	3620	4560	5700
MIN.	260	760	1460	2120	2740	3400	4660

COMMENTS:
(1) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE TORQUED TO 30,000 OR 50,000 PSI ONLY TO PREVENT RUPTURE OF THE SOCKET & HEX. WRENCH AT VALUES OF TORQUE ABOVE 8000 IN-LB.
(2) SPACER BLOCKS WERE SMOKED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCORING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

WADC TR 57-330

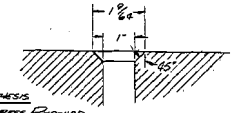
96

DATE — 15 MARCH 1957
SIZE — J, 1-14 UNF-3A
SCREW OR BOLT — MS-20016-50 MFD. BY AIRCRAFT BOLT CORP, EL MONTE, CAL.
NUT — 3-66-142 MFD. BY ELASTIC STOP NUT CORP, UNION, N.J.
2-63 FW-1018 MFD. BY FLECLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.
(NUT FOR BOLT MARKED (2) FURNISHED BY LOCKHEED AIRCRAFT CORP., BURBANK, CAL.
" " " " (3) " BOEING AIRPLANE CO., WITCHITA, KAN.)

TEST CELL — N°
TORSION — GAGE
COMPRESSION — SD

TEST DATA
CONTRACT N° AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SIXTEEN SHANK HEAD COUNTERSUNK IN HARDENED STEEL SPACING BLOCK (ROCKWELL C-55 SCALE 60)

J

NON LUBRICATED

TORQUED FROM HEAD

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN-#)	30,000 TORQUE (IN-#)	50,000 TORQUE (IN-#)	70,000 TORQUE (IN-#)	90,000 TORQUE (IN-#)	110,000 TORQUE (IN-#)	THEORETICAL YIELD POINT 120,000 TORQUE (IN-#)
INITIAL TORQUING							
1H	800	4320	7540	11000	14260		
2H	1600	5280	8760 (1)				
3H	1200	4600	8500 (1)				
(A)4H	1000	3600	6000 (1)				
(B)5H	800	2500	4040 (1)				
AVE.	1080	4060	6968	11000	14260		
MAX.	1600	5280	8760	11000	14260		
MIN.	800	2500	4040	11000	14260		
2ND TORQUING							
1H	1800	7600	12000	14880	← RECESSED HEAD SOCKET AND HEX. WRENCH RUPTURED.		
2H	2800	7700	11540 (1)				
3H	3120	8600	12940 (1)				
(A)4H	1500	5400	8360 (1)				
(B)5H	1700	3860	5860 (1)				
AVE.	2184	6632	10140	14880			
MAX.	3120	8600	12940	14880			
MIN.	1500	3860	5860	14880			
3RD TORQUING							
1H	TEST	DISCONTINUED					
2H	3200	8300	12360 (1)				
3H	3400	9960	14680	← RECESSED HEAD SOCKET AND HEX. WRENCH RUPT'D.			
(A)4H	2500	6700	10000 (1)				
(B)5H	2300	5300	7700 (1)				
AVE.	2850	7565	11185				
MAX.	3400	9960	14680				
MIN.	2300	5300	7700				
4TH TORQUING							
1H							
2H	3020	8400	12480 (1)				
3H	TEST	DISCONTINUED					
(A)4H	2900	7500	10720 (1)				
(B)5H	2700	6300	9040 (1)				
AVE.	2873	7400	10747				
MAX.	3020	8400	12480				
MIN.	2700	6300	9040				
5TH TORQUING							
1H							
2H	3200	8480	12500 (1)				
3H							
(A)4H	3000	7300	10720 (1)				
(B)5H	3160	6760	9600 (1)				
AVE.	3120	7513	10940				
MAX.	3400	8480	12500				
MIN.	3000	6760	9600				

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN-#)	30,000 TORQUE (IN-#)	50,000 TORQUE (IN-#)	70,000 TORQUE (IN-#)	90,000 TORQUE (IN-#)	110,000 TORQUE (IN-#)	THEORETICAL YIELD POINT 120,000 TORQUE (IN-#)
1N	860	2900	5100	7280	9760	12040	
2N	1600	5840	9740	13580	17100	19960	
3N	480	3520	6120	8620	10860	13220	
(A)4N	600	2380	3560	4560	5700	7000	
(B)5N	700	2300	3980	5740	7580	9360	
AVE.	848	2388	5700	7956	10200	12316	
MAX.	1600	5840	9740	13580	17100	19960	
MIN.	480	2300	3560	4560	5700	7000	
1N	1500	5540	8300	10700	13080	15220	
2N	2800	8200	12140	15780	18620	21000	
3N	2200	5440	8140	10760	13260	15300	
(A)4N	2100	3700	5160	6740	8420	10240	
(B)5N	1700	4220	6560	8800	10760	12620	
AVE.	2060	5420	8060	10556	12828	14878	
MAX.	2800	8200	12140	15780	18620	21000	
MIN.	1500	3700	5160	6740	8420	10240	
1N	1200	5920	8800	11420	13600	15660	
2N	3300	8700	13040	16580	19600	22200	
3N	2400	5820	8660	11460	13960	16200	
(A)4N	1800	5760	6560	8560	10340	11980	
(B)5N	1980	5060	7660	10240	12640	14940	
AVE.	2036	6252	8944	11652	14128	16196	
MAX.	3300	8700	13040	16580	19600	22200	
MIN.	1200	5060	6560	8560	10340	11980	
1N	1400	6200	9440	12200	14640	17000	
2N	3700	8560	12940	16560	19500	22000	
3N	1600	6400	9640	12540	15160	17580	
(A)4N	2980	5500	7660	9800	11660	13380	
(B)5N	2300	5660	8320	11040	13660	16260	
AVE.	2396	6464	9600	12428	14924	17244	
MAX.	3700	8560	12940	16560	19500	22000	
MIN.	1400	5500	7660	9800	11660	13380	
1N	2000	6700	9960	13120	15840	18200	21060
2N	3820	9400	13100	16840	19700	22380	25020
3N	2980	7420	10400	14500	17200	19400	22100
(A)4N	2840	5800	8300	10740	12880	14620	16900
(B)5N	2420	6060	8960	11900	14660	17280	21000
AVE.	2812	7076	10144	13420	16056	18376	21210
MAX.	3820	9400	13100	16840	19700	22380	25020
MIN.	2000	5800	8300	10740	12880	14620	16900

LUBRICATED

TORQUED FROM HEAD

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN-#)	30,000 TORQUE (IN-#)	50,000 TORQUE (IN-#)	70,000 TORQUE (IN-#)	90,000 TORQUE (IN-#)	110,000 TORQUE (IN-#)	THEORETICAL YIELD POINT 120,000 TORQUE (IN-#)
1H-L	200	940	1720	2800	4020	5420	
2H-L	180	900	1700	2660	3800	5160	
3H-L	140	900	1800	2800	4020	5380	
(A)4H-L	400	1520	2340	3480	4900	6280	
(B)5H-L	220	1180	2180	3360	4760	6340	
AVE.	228	1088	1948	3080	4320	5716	
MAX.	400	1520	2340	3480	4900	6340	
MIN.	140	900	1700	2660	3800	5160	
1H-L	200	920	1860	3000	4280	5640	
2H-L	160	780	1720	2880	4180	5500	
3H-L	160	860	1740	2880	4060	5360	
(A)4H-L	260	1240	2040	3100	4300	5600	
(B)5H-L	200	1160	2080	3200	4400	5700	
AVE.	196	992	1888	3012	4244	5640	
MAX.	260	1240	2080	3200	4400	5700	
MIN.	160	780	1720	2880	4060	5360	
1H-L	150	1000	2100	3300	4620	5840	
2H-L	100	920	2000	3140	4380	5760	
3H-L	120	900	1960	3000	4220	5420	
(A)4H-L	500	1340	2300	3400	4600	5760	
(B)5H-L	200	1240	2300	3420	4620	5880	
AVE.	214	1080	2132	3252	4488	5732	
MAX.	500	1340	2300	3420	4620	5880	
MIN.	100	900	1960	3000	4220	5420	
1H-L	220	1100	2260	3400	4780	5980	
2H-L	120	920	1900	3260	4600	5940	
3H-L	220	1000	2100	3300	4500	5700	
(A)4H-L	240	1200	2180	3320	4460	5620	
(B)5H-L	240	1300	2500	3800	5020	6300	
AVE.	208	1164	2188	3416	4690	5988	
MAX.	240	1300	2500	3800	5020	6300	
MIN.	120	920	1900	3260	4460	5620	
1H-L	150	1080	2240	3460	4760	6000	7700
2H-L	220	1000	2200	3580	5000	6240	7860
3H-L	160	900	2000	3220	4400	5520	7340
(A)4H-L	260	1260	2320	3500	4640	5840	7580
(B)5H-L	200	1700	2800	4160	5400	6880	9060
AVE.	198	1188	2312	3584	4844	6094	7908
MAX.	260	1700	2800	4160	5400	6880	9060
MIN.	150	900	2000	3220	4400	5520	7340

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN-#)	30,000 TORQUE (IN-#)	50,000 TORQUE (IN-#)	70,000 TORQUE (IN-#)	90,000 TORQUE (IN-#)	110,000 TORQUE (IN-#)	THEORETICAL YIELD POINT 120,000 TORQUE (IN-#)
1N-L	150	900	1840	2900	4020	5280	
2N-L	160	800	1800	2940	4300	5720	
3N-L	160	800	1920	3100	4600	6080	
(A)4N-L	200	1100	1760	2660	3760	5140	
(B)5N-L	240	1080	1700	2100	3760	5040	
AVE.	182	936	1804	2740	4088	5452	
MAX.	240	1100	1920	3100	4600	6080	
MIN.	150	800	1700	2100	3760	5040	
1N-L	200	800	1900	3100	4220	5660	
2N-L	120	820	2100	3460	4840	6180	
3N-L	200	1020	2280	3820	5260	6300	
(A)4N-L	160	1060	2020	3020	4400	5900	
(B)5N-L	240	880	1640	2660	3740	5040	
AVE.	184	916	1988	3212	4492	5796	
MAX.	240	1060	2280	3820	5260	6300	
MIN.	120	800	1640	2660	3740	5040	
1N-L	160	680	1820	2960	4340	5780	
2N-L	140	960	2180	3500	4900	6000	
3N-L	150	1080	2340	3800	5200	6400	
(A)4N-L	180	1300	2480	3800	4900	6020	
(B)5N-L	220	900	1700	2800	4060	5500	
AVE.	170	984	2104	3372	4680	5940	
MAX.	220	1300	2480	3800	5200	6400	
MIN.	140	680	1700	2800	4060	5500	
1N-L	140	680	1860	3160	4540	5740	
2N-L	120	760	2000	3360	4720	5900	
3N-L	220	1080	2420	3800	5240	6400	
(A)4N-L	240	1500	2600	3740	4980	6180	
(B)5N-L	160	880	1740	2660	3800	5260	
AVE.	176	980	2124	3344	4676	5896	
MAX.	240	1500	2600	3800	5240	6400	
MIN.	120	680	1740	2660	3800	5260	
1N-L	120	720	1880	3180	4520	5760	7500
2N-L	140	780	1900	2960	4280	5700	7700
3N-L	300	1400	2700	4000	5260	6380	7980
(A)4N-L	300	1560	2560	3760	4940	6200	8000
(B)5N-L	160	1020	2000	3340	4420	5560	7560
AVE.	204	1096	2208	3448	4668	5940	7748
MAX.	300	1560	2700	4000	5260	6380	8000
MIN.	120	720	1880	2960	4280	5560	7500

COMMENTS:
(1) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE TORQUED TO 50,000 PSI ONLY TO PREVENT RUPTURES OF THE SOCKET & HEX. WRENCH AT VALUES OF TORQUE ABOVE 14,000 IN-LB.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN 'L' AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

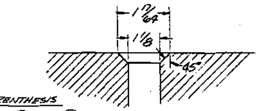
DATE — 21 MARCH 1957
SIZE — K, 1 1/8-12 UNF-3A
SCREW OR BOLT — MS-20018-50 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — 3-EB-182 MFD. BY ELASTIC STOP NUT CORP., UNION, N.J.
2-42 EW-1812 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.
(NUT FOR BOLT MARKED (B) FURNISHED BY BOEING AIRPLANE CO., WITCHITA, KAN.)

TEST CELL — Nº
TORSION — 6A & 6B
COMPRESSION — 50

TEST DATA

CONTRACT Nº AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS
DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD
COUNTERSINK IN HARDENED
STEEL SPACING BLOCK
(ROCKWELL "C" SCALE 60)

K

NON LUBRICATED

TORQUED FROM HEAD

Tensile Stress (#/in²) — Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1H	1400	4400	7460	(1)			
	2H	1100	5000	8380	(1)			
	3H	1700	5320	9180	(1)			
	(B)4H	1700	4400	7360	(1)			
	(B)5H	1800	5100	8460	(1)			
	AVE.	1540	4844	8168				
	MAX.	1800	5320	9180				
	MIN.	1100	4400	7360				
2nd Torquing	1H	2080	5540	9040	(1)			
	2H	3000	7220	11200	(1)			
	3H	2880	7860	12320	(1)			
	(B)4H	2960	7160	10900	(1)			
	(B)5H	3760	8340	12880	(1)			
	AVE.	2936	7224	11268				
	MAX.	3760	8340	12880				
	MIN.	2080	5540	9040				
3rd Torquing	1H	2980	7100	10600	(1)			
	2H	3166	7980	12240	(1)			
	3H	3000	7980	13000	(1)			
	(B)4H	3700	8900	13220	(1)			
	(B)5H	4080	9920	14600	(1)			
	AVE.	3385	8376	12732				
	MAX.	4080	9920	14600				
	MIN.	2980	7100	10600				
4th Torquing	1H	3400	8100	12240	(1)			
	2H	3420	8300	12460	(1)			
	3H	3220	8100	12920	(1)			
	(B)4H	3620	9220	13580	(1)			
	(B)5H	4040	9980	14760	(1)			
	AVE.	3540	8740	12992				
	MAX.	4040	9980	14760				
	MIN.	3220	8100	12240				
5th Torquing	1H	4020	9400	14000	(1)			
	2H	3460	8100	16540	(1)			
	3H	2760	8100	13000	(1)			
	(B)4H	4000	9580	14040	(1)			
	(B)5H	4100	10100	14980	(1)			
	AVE.	3668	9056	14512				
	MAX.	4100	10100	16540				
	MIN.	2760	8100	13000				

TORQUED FROM NUT

Tensile Stress (#/in²) — Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1N	1860	5480	9740	13780	18020	21600	
	2N	1000	3880	6800	9600	12000	15000	
	3N	1600	3400	5600	9000	10400	13600	
	(B)4N	1400	3800	8600	11200	14600	17000	
	(B)5N	1400	3000	4600	6600	8000	10400	
	AVE.	1452	3912	7068	9836	12604	15520	
	MAX.	1860	5480	9740	13780	18020	21600	
	MIN.	1000	3000	4600	6600	8000	10400	
2nd Torquing	1N	2620	7700	11540	15580	19000	22380	
	2N	2000	4000	7000	9200	12600	14600	
	3N	2400	5600	8600	11400	14600	18000	
	(B)4N	3000	7000	10800	13600	11000	19600	
	(B)5N	1200	3400	5200	7200	10000	11600	
	AVE.	2244	5540	8628	11396	14640	17236	
	MAX.	3000	7700	11540	15580	19000	22380	
	MIN.	1200	3400	5200	7200	10000	11600	
3rd Torquing	1N	3040	7920	12080	15860	19360	22560	
	2N	2200	5200	8000	11000	13600	17000	
	3N	2800	7400	10800	15000	19200	22400	
	(B)4N	3600	8000	12000	15600	19000	22000	
	(B)5N	1800	4400	7000	9000	11600	14000	
	AVE.	2688	6584	9976	13292	16552	19592	
	MAX.	3600	8000	12080	15860	19360	22560	
	MIN.	1800	4400	7000	9000	11600	14000	
4th Torquing	1N	3800	9200	13800	18000	21800	25200	
	2N	2600	6000	9000	13000	16400	19600	
	3N	3200	7200	13000	18000	22000	25600	
	(B)4N	3400	8600	12600	17000	20200	23000	
	(B)5N	1800	4400	7000	9800	12000	14000	
	AVE.	2960	7080	11080	15160	18480	21480	
	MAX.	3800	9200	13800	18000	22000	25600	
	MIN.	1800	4400	7000	9800	12000	14000	
5th Torquing	1N	3600	8800	13400	18000	22000	25400	30200
	2N	3000	7000	11000	15000	18600	21600	27000
	3N	3000	8400	13800	19800	24200	27800	32600
	(B)4N	3600	9200	13600	17600	21000	24000	28000
	(B)5N	1800	4800	7200	10000	12600	14600	18000
	AVE.	3000	7640	11800	16080	19680	22680	27160
	MAX.	3600	9200	13800	19800	24200	27800	32600
	MIN.	1800	4800	7200	10000	12600	14600	18000

LUBRICATED

TORQUED FROM HEAD

Tensile Stress (#/in²) — Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1H-L	(3) L 400	1500	2780	4200	6160	8120	
	2H-L	L 420	1340	2480	3900	5600	7340	
	3H-L	L 300	1300	2440	4000	5560	7440	
	(B)4H-L	L 500	1600	2780	4020	5460	7080	
	(B)5H-L	L 400	1260	2500	3620	5120	6600	
	AVE.	404	1400	2596	3948	5580	7316	
	MAX.	500	1600	2780	4200	6160	8120	
	MIN.	300	1260	2440	3620	5120	6600	
2nd Torquing	1H-L	L 520	1500	2900	4400	6100	7840	
	2H-L	L 460	1500	2700	4180	5800	7480	
	3H-L	L 260	1240	2460	4020	5620	7260	
	(B)4H-L	L 480	1500	2680	4040	5600	7200	
	(B)5H-L	L 460	1460	2620	3960	5300	6800	
	AVE.	436	1440	2672	4120	5684	7316	
	MAX.	520	1500	2900	4400	6100	7840	
	MIN.	260	1240	2460	3960	5300	6800	
3rd Torquing	1H-L	L 520	1580	3000	4600	6240	7900	
	2H-L	L 420	1520	2860	4540	6180	7800	
	3H-L	L 300	1300	2680	4300	5900	7400	
	(B)4H-L	L 480	1560	2940	4520	6020	7600	
	(B)5H-L	L 480	1520	2800	4120	5720	7080	
	AVE.	440	1496	2856	4416	6012	7556	
	MAX.	520	1580	3000	4600	6240	7900	
	MIN.	300	1300	2680	4120	5720	7080	
4th Torquing	1H-L	L 460	1600	3000	4720	6500	8100	
	2H-L	L 480	1520	3020	4700	6100	7800	
	3H-L	L 300	1400	2740	4360	5940	7620	
	(B)4H-L	L 520	1560	2840	4220	5820	7280	
	(B)5H-L	L 500	1560	2880	4300	5920	7600	
	AVE.	452	1528	2896	4460	6056	7680	
	MAX.	520	1600	3020	4720	6500	8100	
	MIN.	300	1400	2740	4220	5820	7280	
5th Torquing	1H-L	L 480	1600	3060	4620	6220	7900	10980
	2H-L	L 420	1500	3100	4620	6260	8020	10540
	3H-L	L 320	1300	2800	4260	5820	7300	9960
	(B)4H-L	L 520	1500	2900	4160	5880	7400	9880
	(B)5H-L	L 540	1620	2900	4260	5820	7260	9800
	AVE.	456	1504	2952	4384	6000	7576	10232
	MAX.	540	1620	3100	4620	6260	8020	10980
	MIN.	320	1300	2800	4160	5820	7260	9800

TORQUED FROM NUT

Tensile Stress (#/in²) — Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1N-L	(3) L 500	1600	3000	5020	7080	9360	
	2N-L	L 500	1620	2900	4720	6860	8700	
	3N-L	L 600	1740	3100	4900	6600	8220	
	(B)4N-L	L 460	1580	2600	3700	5020	6460	
	(B)5N-L	L 460	1180	2300	3580	5060	6580	
	AVE.	504	1544	2780	4384	6124	7864	
	MAX.	600	1740	3100	5020	7080	9360	
	MIN.	460	1180	2300	3580	5020	6460	
2nd Torquing	1N-L	L 480	1600	3120	5020	6940	9000	
	2N-L	L 480	1560	3120	5040	6920	8800	
	3N-L	L 520	1940	3480	5100	6800	8540	
	(B)4N-L	L 680	1420	2380	3600	4880	6280	
	(B)5N-L	L 480	1240	2360	3860	5300	6860	
	AVE.	528	1552	2892	4524	6168	7896	
	MAX.	680	1940	3480	5100	6940	9000	
	MIN.	480	1240	2360	3600	4880	6280	
3rd Torquing	1N-L	L 500	1600	3300	5060	6800	8660	
	2N-L	L 520	1560	3060	4900	6760	8500	
	3N-L	L 540	1760	3560	5380	7240	8760	
	(B)4N-L	L 600	1400	2500	3760	5380	7000	
	(B)5N-L	L 400	1200	2600	4000	5460	7000	
	AVE.	512	1504	3004	4620	6328	7984	
	MAX.	600	1760	3560	5380	7240	8760	
	MIN.	400	1200	2500	3760	5380	7000	
4th Torquing	1N-L	L 600	1700	3160	4900	6700	8500	
	2N-L	L 480	1560	2900	4880	6600	8580	
	3N-L	L 560	1700	3320	5400	7100	8760	
	(B)4N-L	L 600	1400	2540	3900	5400	7060	
	(B)5N-L	L 400	1300	2600	4100	5580	7280	
	AVE.	528	1532	2904	4636	6276	8036	
	MAX.	600	1700	3320	5400	7100	8760	
	MIN.	400	1300	2540	3900	5400	7060	
5th Torquing	1N-L	L 480	1580	3040	4700	6600	8260	11420
	2N-L	L 400	1500	3060	4900	6520	8400	11280
	3N-L	L 520	1640	3300	5440	7220	8940	11600
	(B)4N-L	L 560	1600	2600	4000	5540	7220	9860
	(B)5N-L	L 460	1440	2740	4380	5940	7600	10300
	AVE.	484	1552	2948	4684	6364	8084	10892
	MAX.	560	1600	3300	5440	7220	8940	11600
	MIN.	400	1440	2600	4000	5540	7220	9860

COMMENTS:
(1) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE TORQUED TO 50,000 PSI ONLY TO PREVENT RUPTURE OF THE SOCKET & HEX. WRENCH AT VALUES OF TORQUE ABOVE 15,000 IN-LB.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

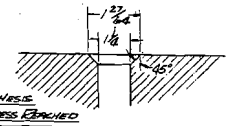
PAGE 1A

DATE — 4 APRIL, '57
SIZE — L, 1⅛-12 UNF-3A
SCREW OR BOLT — MS-20020-30 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — EB-702 MFD. BY ELASTIC STOP NUT CORP., UNION, N.J.

TEST CELL — N°
TORSION — GR&LB
COMPRESSION — SD

TEST DATA
CONTRACT N° AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL 'C' - SCALE 60)

L

NON LUBRICATED

TORQUED FROM HEAD

TORQUING N°	SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN-#)	30,000 TORQUE (IN-#)	50,000 TORQUE (IN-#)	70,000 TORQUE (IN-#)	90,000 TORQUE (IN-#)	110,000 TORQUE (IN-#)	THEORETICAL YIELD POINT 140,000 TORQUE (IN-#)
INITIAL TORQUING	1H	1300	4660	7840	11680 (2)			
	2H	1900	8200	13400	18400	28000 (4)		
	3H	2600	8000	14400	20600 (1)			
	4H	2200	7000	12800	19600 (1)			
	5H	2000	8400	14600	20200 (1)			
	AVE.	2000	7252	12608	18096			
	MAX.	2600	8400	14600	20600			
	MIN.	1300	4660	7840	11680			
2ND TORQUING	1H	1860	5140	8600	11080 (1)			
	2H	4000	11600	20400	24600	30400 (4)		
	3H	4600	13000	20000	25000 (1)			
	4H	3800	11800	19000	25600 (1)			
	5H	3400	11600	18400	24800 (1)			
	AVE.	3532	10628	17280	22216			
	MAX.	4600	13000	20400	25600			
	MIN.	1860	5140	8600	11080			
3RD TORQUING	1H	2380	5900	9200	12560 (1)			
	2H	4400	11800	19000	25400	30800 (4)		
	3H	4000	12000	19000	25200 (1)			
	4H	4200	13000	20200	26000 (1)			
	5H	3600	11000	17800	24000 (1)			
	AVE.	3716	10740	17440	22632			
	MAX.	4600	13000	20200	26000			
	MIN.	2380	5900	9200	12560			
4TH TORQUING	1H	2700	6720	10600	14080 (1)			
	2H	4000	12000	19000	25000	30200 (4)		
	3H	4000	12000	18000	25000 (1)			
	4H	4000	12600	20000	26000 (1)			
	5H	3200	11200	17400	23000 (1)			
	AVE.	3580	10904	17000	22616			
	MAX.	4000	12600	20000	26000			
	MIN.	2700	6720	10600	14080			
5TH TORQUING	1H	3060	7740	11740	15480	18980	22400	
	2H	4800	12400	19600	25600	32200 (4)		
	3H	4000	12000	18600	25000 (1)			
	4H	4000	12400	20000	26200 (1)			
	5H	3800	11200	18000	23600 (1)			
	AVE.	3932	11148	17588	23176			
	MAX.	4800	12400	20000	26200			
	MIN.	3060	7740	11740	15480			

(4,000 PSI) RECESSED HEAD SOCKET & HEX. WRENCH RUPTURED

TORQUED FROM NUT

TORQUING N°	SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN-#)	30,000 TORQUE (IN-#)	50,000 TORQUE (IN-#)	70,000 TORQUE (IN-#)	90,000 TORQUE (IN-#)	110,000 TORQUE (IN-#)	THEORETICAL YIELD POINT 140,000 TORQUE (IN-#)
INITIAL TORQUING	1N	1200	3400	5800	8600	11400	14000	
	2N	1400	4800	8800	12800	17000	20800	
	3N	2000	6600	11600	16400	21000	25400	
	4N	1800	4200	7600	11400	15200	18600	
	5N	1800	6000	10600	15000	19000	23000	
	AVE.	1640	5000	8880	12840	16720	20360	
	MAX.	2000	6600	11600	16400	21000	25400	
	MIN.	1200	3400	5800	8600	11400	14000	
2ND TORQUING	1N	1600	4000	6200	8800	11200	14000	
	2N	2600	7000	10800	14600	18600	22400	
	3N	3000	8800	13000	17400	21400	25600	
	4N	2400	5600	8800	11800	14600	17800	
	5N	3400	8600	13400	18000	22800	27600	
	AVE.	2600	6800	10440	14120	17720	21480	
	MAX.	3400	8800	13400	18000	22800	27600	
	MIN.	1600	4000	6200	8800	11200	14000	
3RD TORQUING	1N	1800	4600	7200	10000	12800	15600	
	2N	3800	8600	13400	17600	22000	26000	
	3N	4000	10400	16200	21200	25600	29800	
	4N	2600	6400	9400	12200	15400	18400	
	5N	3600	10200	16000	21600	26600	31000	
	AVE.	3160	8040	12440	16520	20480	24160	
	MAX.	4000	10400	16200	21600	26600	31000	
	MIN.	1800	4600	7200	10000	12800	15600	
4TH TORQUING	1N	1800	5000	7200	10600	13600	16600	
	2N	4000	10000	15400	20600	25600	28600	
	3N	4800	12600	19200	25000	29600	32000	
	4N	2600	6600	9800	13000	15800	18800	
	5N	4000	11800	18600	24200	29000	32400	
	AVE.	3440	9200	14040	18680	22720	25680	
	MAX.	4800	12600	19200	25000	29600	32000	
	MIN.	1800	5000	7200	10600	13600	16600	
5TH TORQUING	1N	2000	5000	8000	11000	14000	16800	22000
	2N	4200	11000	17000	22400	27200	32000	38000
	3N	5400	14000	21000	26800	32000	36600	42600
	4N	3000	6800	10000	13000	16000	19400	23800
	5N	4200	12600	20000	25600	30800	35000	40600
	AVE.	3760	9880	15200	19760	24000	27960	33400
	MAX.	5400	14000	21000	26800	32000	36600	40600
	MIN.	2000	5000	8000	11000	14000	16800	22000

LUBRICATED

TORQUED FROM HEAD

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN-#)	30,000 TORQUE (IN-#)	50,000 TORQUE (IN-#)	70,000 TORQUE (IN-#)	90,000 TORQUE (IN-#)	110,000 TORQUE (IN-#)	THEORETICAL YIELD POINT 140,000 TORQUE (IN-#)
1H-L	700	1500	3400	5940	8040	10400	
2H-L	740	2200	3860	5720	8320	10840	
3H-L	800	2200	3820	5820	8600	11160	
4H-L	780	2100	3620	5800	8160	10760	
5H-L	540	2100	3800	6000	8500	11200	
AVE.	712	2020	3720	5856	8344	10872	
MAX.	800	2200	3860	6000	8600	11200	
MIN.	540	1500	3400	5720	8040	10400	
1H-L	4000	2700	4340	6200	8420	10600	
2H-L	600	1980	3700	5560	8000	10120	
3H-L	760	2340	4100	5920	8140	10060	
4H-L	740	2200	3800	5880	8240	10640	
5H-L	560	2200	3940	5900	7920	10100	
AVE.	732	2284	3976	5892	8144	10304	
MAX.	1000	2700	4340	6200	8420	10640	
MIN.	560	1980	3700	5560	7920	10060	
1H-L	1000	2500	4500	6560	8940	11220	
2H-L	640	2100	4000	6000	8200	10600	
3H-L	880	2560	4400	6440	8760	11120	
4H-L	640	2300	4240	6360	8900	11100	
5H-L	700	2300	4400	6440	8740	10900	
AVE.	772	2352	4308	6360	8708	10988	
MAX.	1000	2560	4500	6560	8940	11220	
MIN.	640	2100	4000	6000	8200	10600	
1H-L	900	2560	4400	6600	9100	11300	
2H-L	900	2200	3940	6200	8600	10940	
3H-L	920	2400	4340	6500	8800	11420	
4H-L	740	2400	4460	6860	9120	11600	
5H-L	760	2180	4400	6420	8760	11000	
AVE.	844	2348	4308	6516	8876	11252	
MAX.	920	2560	4460	6860	9120	11600	
MIN.	740	2180	3940	6200	8600	10940	
1H-L	800	2400	4160	6500	9000	11700	15200
2H-L	800	2160	4060	6200	8700	11200	12960
3H-L	740	2300	4500	6700	9200	11740	16380
4H-L	700	2200	4140	6540	9040	11640	15300
5H-L	700	2300	4360	6300	8700	10900	14660
AVE.	748	2268	4244	6448	8928	11440	14900
MAX.	800	2400	4500	6700	9200	11740	16380
MIN.	700	2140	4060	6200	8700	10900	12960

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN-#)	30,000 TORQUE (IN-#)	50,000 TORQUE (IN-#)	70,000 TORQUE (IN-#)	90,000 TORQUE (IN-#)	110,000 TORQUE (IN-#)	THEORETICAL YIELD POINT 140,000 TORQUE (IN-#)
1N-L	1400	2400	4600	6600	9400	11800	
2N-L	400	2400	4600	7000	9800	12600	
3N-L	1600	3200	4600	6600	9000	11600	
4N-L	660	2000	3960	6260	8740	11300	
5N-L	680	2100	3960	6160	8760	11360	
AVE.	748	2420	4344	6524	9140	11732	
MAX.	1600	3200	4600	7000	9800	12600	
MIN.	400	2000	3960	6160	8740	11300	
1N-L	800	2400	4800	7000	9400	11600	
2N-L	800	2200	3000	4800	7400	10000	
3N-L	1200	2000	3600	5600	8200	10800	
4N-L	700	2200	4200	6140	8280	10600	
5N-L	700	2400	4420	6980	9600	12200	
AVE.	840	2240	4004	6704	8576	11040	
MAX.	1200	2400	4800	7000	9600	12200	
MIN.	700	2000	3600	4800	7400	10000	
1N-L	800	2200	4600	6600	8600	11000	
2N-L	600	2200	4000	5800	7800	9600	
3N-L	400	1600	3600	5400	8200	11000	
4N-L	800	2300	4520	6940	9020	11240	
5N-L	580	2100	4320	6900	9600	12200	
AVE.	636	2080	4208	6328	8644	11008	
MAX.	800	2300	4600	6940	9600	12200	
MIN.	400	1600	3600	5400	7800	9600	
1N-L	600	2000	4200	6600	8600	10800	
2N-L	800	2600	4800	6600	8600	11000	
3N-L	600	1400	3200	5600	8000	11000	
4N-L	680	2260	4440	6760	8900	11200	
5N-L	600	2100	4260	6900	9360	11940	
AVE.	656	2072	4180	6492	8692	11188	
MAX.	800	2600	4800	6900	9360	11940	
MIN.	600	1400	3200	5600	8000	10800	
1N-L	400	1000	4400	6800	8800	11000	15000
2N-L	800	2600	4800	6600	8600	11000	14600
3N-L	600	2000	4200	6600	9000	11800	16000
4N-L	780	2400	4420	6840	9060	11240	14600
5N-L	500	2000	4100	6800	9400	11900	15760
AVE.	616	2000	4384	6728	8972	11388	15192
MAX.	800	2600	4800	6840	9400	11900	16000
MIN.	400	1000	4100	6600	8600	11000	14600

COMMENTS:
(1) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE TORQUED TO 70,000 PSI ONLY TO PREVENT RUPTURE OF THE RECESSED HEAD SOCKET AND HEX. WRENCH AT VALUES OF TORQUE ABOVE 36,000 IN-LB.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) BOLT 2N WAS TORQUED TO 39000 PSI TO SEE IF FIVE TORQUINGS TO THIS VALUE COULD BE RUN WITHOUT HEAD RUPTURE. TORQUE VALUES OF 1N INDICATED THAT IT MIGHT BE POSSIBLE.

DATE — 11 APRIL 1957
SIZE — M, 1 3/8-12 UNF-3A
SCREW OR BOLT — MS-20022-52 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT — EB-222 MFD. BY ELASTIC STOP NUT CORP., UNION, N.J.

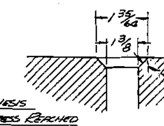
TEST CELL — Nº
TORSION — GA86B
COMPRESSION — 50

TEST DATA

CONTRACT Nº AF 33(616)2808

P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

M

NON LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1H	4600	11400	17000	22000	(1)		
	2H	6600	14000	20000	24600	29800	(4)	
	3H	7000	16000	24400	31200	38000	(4)	
	4H	6400	16800	25400	32600	(1)		
	5H	6000	14000	20800	27000	(1)		
	AVE.	6120	14440	21520	27480			
	MAX.	7000	16800	25400	32600			
	MIN.	4600	11400	17000	22000			
2nd Torquing	1H	6000	13400	19000	24600	(1)		
	2H	8000	16000	22200	27400	32800	(4)	
	3H	10600	23400	31600	39000	45400	(4)	
	4H	9200	20400	26800	34000	(1)		
	5H	8600	17600	24400	30200	(1)		
	AVE.	8480	18160	24800	31000			
	MAX.	10600	23400	31600	39000			
	MIN.	6000	13400	19000	24600			
3rd Torquing	1H	7400	15600	21400	26000	(1)		
	2H	8600	18200	25400	31000	36400	(4)	
	3H	11200	25000	34000	42000	(1)		
	4H	10200	21000	28400	36200	(1)		
	5H	10000	19400	26200	32000	(1)		
	AVE.	9480	19840	27080	33440			
	MAX.	11200	25000	34000	42000			
	MIN.	7400	15600	21400	26000			
4th Torquing	1H	8000	17000	22600	27400	(1)		
	2H	10400	21400	28000	34400	40000	(4)	
	3H	11800	25800	34600	42800	(1)		
	4H	11000	22400	30000	36600	(1)		
	5H	10000	20000	27000	33000	(1)		
	AVE.	10240	21320	28440	34840			
	MAX.	11800	25800	34600	42800			
	MIN.	8000	17000	22600	27400			Recessed head socket ruptured out
5th Torquing	1H	9000	18400	25000	30000	35000	40000	50,000
	2H	10600	21800	29600	36000	42000	(4)	
	3H	11600	26400	35000	43200	(1)		
	4H	10800	22600	30400	37000	(1)		
	5H	10000	20600	28200	34800	(1)		
	AVE.	10400	21960	29640	36200			
	MAX.	11600	26400	35000	43200			
	MIN.	9000	18400	25000	30000			

NON LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1N	4200	11800	18600	25000	32000	37600	
	2N	4400	12400	20600	27400	33400	38800	
	3N	4400	10800	15000	19400	22200	25400	
	4N	4400	11200	17600	23600	30400	36200	
	5N	4400	11000	16000	20000	24600	28200	
	AVE.	4360	11440	17560	23080	28520	33240	
	MAX.	4400	12400	20600	27400	33400	38800	
	MIN.	4200	10800	15000	19400	22200	25400	
2nd Torquing	1N	6000	14600	20600	25600	30600	35400	
	2N	6800	16000	22200	27200	32600	38000	
	3N	5400	11000	15000	18600	21800	25200	
	4N	5000	11400	17000	21600	26800	31600	
	5N	5600	12000	16600	20800	25000	29200	
	AVE.	5760	13000	18280	22760	27360	31880	
	MAX.	6800	16000	22200	27200	32600	38000	
	MIN.	5000	11000	15000	18600	21800	25200	
3rd Torquing	1N	6800	16000	22000	26800	32000	36600	
	2N	8600	18000	24800	30200	35800	41000	
	3N	6400	12400	16600	20600	23600	27200	
	4N	5400	12400	18000	22800	28000	33000	
	5N	7200	15000	20000	24200	29200	33600	
	AVE.	6880	14760	20280	24920	29720	34280	
	MAX.	8600	18000	24800	30200	35800	36600	
	MIN.	5400	12400	16600	20600	23600	27200	
4th Torquing	1N	8200	17200	23600	29000	33800	38200	
	2N	9400	20400	27000	33000	39200	45000	
	3N	6400	13000	17600	21200	24600	28200	
	4N	6400	13900	19600	24800	29400	35000	
	5N	9000	16600	22200	28000	30400	36000	
	AVE.	7880	16200	22040	27200	31480	36480	
	MAX.	9400	20400	27000	33000	39200	45000	
	MIN.	6400	13000	17600	21200	24600	28200	
5th Torquing	1N	8600	18600	25600	31200	37000	42200	50000
	2N	10000	21000	28200	34600	40200	46200	53600
	3N	6800	14000	18600	22600	26200	29600	36000
	4N	7200	15600	21000	26400	31800	37000	46000
	5N	9200	17400	23600	29000	34000	39000	47000
	AVE.	8360	17320	23400	28760	33840	38800	46520
	MAX.	10000	21000	28200	34600	40200	46200	53600
	MIN.	6800	14000	18600	22600	26200	29600	36000

LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1H-L	(3) L 1400	3600	6200	9600	13000	16600	
	2H-L	L 1400	3200	5400	7800	10600	13800	
	3H-L	L 1200	2800	5200	7600	10800	14000	
	4H-L	L 1000	2800	5400	7800	10800	14000	
	5H-L	L 1200	3200	5800	8400	11200	14600	
	AVE.	1240	3120	5600	8240	11280	14600	
	MAX.	1400	3600	6200	9600	13000	16600	
	MIN.	1000	2800	5200	7600	10600	13800	
2nd Torquing	1H-L	L 1400	3800	7400	10600	14600	18000	
	2H-L	L 1000	3400	6000	8800	12000	15600	
	3H-L	L 1000	3000	6000	9000	12400	15800	
	4H-L	L 1000	3600	6400	9400	12400	15600	
	5H-L	L 1000	3600	6000	9400	12400	15600	
	AVE.	1080	3480	6360	9440	12760	16120	
	MAX.	1400	3800	7400	10600	14600	18000	
	MIN.	1000	3000	6000	8800	12000	15600	
3rd Torquing	1H-L	L 1000	3800	7400	10600	14000	17800	
	2H-L	L 1400	4000	6800	9800	13200	16600	
	3H-L	L 1000	3400	6400	9600	13400	17000	
	4H-L	L 1000	3400	6600	9600	13400	16400	
	5H-L	L 1000	3600	6600	9600	12800	15600	
	AVE.	1080	3640	6760	9840	13360	16680	
	MAX.	1400	4000	7400	10600	14000	17800	
	MIN.	1000	3400	6400	9600	12800	15600	
4th Torquing	1H-L	L 1000	3800	7000	10600	14000	17800	
	2H-L	L 1400	4000	7000	10000	13600	17000	
	3H-L	L 800	3000	6000	9400	13000	16600	
	4H-L	L 1000	3400	6600	9800	13200	16600	
	5H-L	L 1000	3400	6400	9600	13000	16600	
	AVE.	1040	3520	6600	9880	13360	16920	
	MAX.	1400	4000	7000	10600	14000	17800	
	MIN.	800	3000	6000	9400	13000	16600	
5th Torquing	1H-L	L 1200	3800	7000	10400	14000	17600	25000
	2H-L	L 1200	3600	7000	10000	14000	17600	23800
	3H-L	L 800	3200	6200	9600	13200	16800	24200
	4H-L	L 1000	3600	6600	9800	13000	16600	23000
	5H-L	L 1000	3600	6600	10200	13400	17000	23000
	AVE.	1040	3560	6680	10000	13520	17120	23800
	MAX.	1200	3800	7000	10400	14000	17600	25000
	MIN.	800	3200	6200	9600	13000	16600	23000

LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical Yield Point 140,000
Initial Torquing	1N-L	(3) L 1000	3000	5000	7600	10200	13600	
	2N-L	L 1200	3400	6800	9200	12000	14800	
	3N-L	L 1200	3200	5000	7200	10000	13600	
	4N-L	L 1200	3400	5600	8000	11000	14600	
	5N-L	L 1200	3000	5400	7800	10400	13400	
	AVE.	1160	3200	5560	7960	10920	14000	
	MAX.	1200	3400	6800	9200	12000	14800	
	MIN.	1000	3000	5000	7200	10000	13400	
2nd Torquing	1N-L	L 1000	2600	5400	8000	11200	14600	
	2N-L	L 1400	4000	6800	9600	12400	15400	
	3N-L	L 1000	3000	5600	8600	11400	14600	
	4N-L	L 1000	3200	6000	8600	11400	15000	
	5N-L	L 1000	3400	6200	8600	11400	14600	
	AVE.	1080	3240	6000	8680	11560	14840	
	MAX.	1400	4000	6800	9600	12400	[illegible]	
	MIN.	1000	2600	5400	8000	11200	14600	
3rd Torquing	1N-L	L 1000	2800	5800	8600	11600	14000	
	2N-L	L 1000	3600	6200	9400	11800	14800	
	3N-L	L 800	2600	5200	8000	11000	14000	
	4N-L	L 1000	3400	6400	9600	12600	15600	
	5N-L	L 800	3200	6000	8600	11000	14200	
	AVE.	920	3120	5920	8840	11600	14520	
	MAX.	1000	3600	6400	9600	12600	15600	
	MIN.	800	2600	5200	8000	11000	14000	
4th Torquing	1N-L	L 800	2800	5800	9000	12400	15600	
	2N-L	L 1000	3600	6600	9200	12200	15000	
	3N-L	L 800	3200	6400	9400	11800	14600	
	4N-L	L 800	3400	6400	9600	12800	16000	
	5N-L	L 800	3200	6000	8800	11800	14800	
	AVE.	840	3240	6240	9200	12200	15200	
	MAX.	1000	3600	6600	9600	12800	16000	
	MIN.	800	2800	5800	8800	11800	14600	
5th Torquing	1N-L	L 1200	3600	7000	10000	13200	16600	22400
	2N-L	L 1000	3600	6000	8800	12000	15200	21000
	3N-L	L 600	3200	6600	9600	12800	16000	22000
	4N-L	L 800	3400	6600	9600	13000	16400	22000
	5N-L	L 800	3600	6400	9000	12000	15000	21000
	AVE.	880	3480	6520	9400	12600	15840	21680
	MAX.	1200	3600	7000	10000	13200	16600	22400
	MIN.	600	3200	6000	8800	12000	15000	21000

COMMENTS:

(1) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE TORQUED TO 70,000 PSI TO PREVENT RUPTURE OF THE RECESSED HEAD SOCKET AND HEX. WRENCH AT VALUES OF TORQUE ABOVE 45,000 IN-LB.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN 'L' AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) HIGHER VALUES OF STRESS WERE ATTEMPTED UP TO TORQUE VALUES OF 45,000 IN-LB WITH BOLTS 2H & 3H.

PAGE 1A

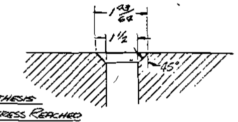
DATE ———— 18 APRIL 1957
SIZE ———— N, 1½-12 UNF-3A
SCREW OR BOLT — MS-20024-52 MFD. BY AIRCRAFT BOLT CORP., EL MONTE, CAL.
NUT ———— EB-242 MFD. BY ELASTIC STOP NUT CORP., UNION, N.J.

TEST CELL — Nº
TORSION — 6A
COMPRESSION — 5D

TEST DATA

CONTRACT Nº AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

N — NON LUBRICATED — TORQUED FROM HEAD

Tensile stress (#/in²); torque (in-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical yield point 140,000
Initial Torquing	1H	15000	27000	34000	[illegible]	46200	(1)	
	2H	11000	21600	29200	36200	42400	(1)	
	3H	13000	27000	37000	[illegible]	53000	(1)	
	4H	11200	21000	28000	[illegible]	43000	(1)	
	5H	10400	21000	28000	35000	41000	(1)	
	AVE.	12120	23520	31240	38400	45120		
	MAX.	15000	27000	37000	44600	53000		
	MIN.	10400	21000	28000	35000	41000		
2nd Torquing	1H	17000	31400	39400	[illegible]	[illegible]	(1)	
	2H	14000	23600	33000	40000	46800	(1)	
	3H	16600	31000	40000	48600	56800	(1)	
	4H	13200	26000	34400	[illegible]	50200	(1)	
	5H	13000	24000	[illegible]	40000	46800	(1)	
	AVE.	14760	27720	35960	43480	50880		
	MAX.	17000	31400	40000	48600	56800		
	MIN.	13000	24600	33000	40000	46800		
3rd Torquing	1H	14200	29000	38000	45800	53200	(1)	
	2H	16400	29200	37600	45400	52600	(1)	
	3H	18000	33000	43200	[illegible]	60800	(1)	
	4H	15200	[illegible]	38000	[illegible]	53400	(1)	
	5H	[illegible]	[illegible]	[illegible]	44000	51000	(1)	
	AVE.	15600	29360	38880	46640	54200		
	MAX.	18000	33000	43200	52000	60800		
	MIN.	14200	27000	37600	44000	51000		
4th Torquing	1H	14400	30000	33800	48200	54800	(1)	
	2H	16400	31000	40000	48600	55600	(1)	
	3H	[illegible]	[illegible]	47600	57200	65400	(1)	
	4H	17200	31200	41000	[illegible]	58000	(1)	
	5H	15600	[illegible]	38400	47000	54400	(1)	
	AVE.	16720	31840	41360	50160	57640		
	MAX.	20000	37000	47600	57200	65400		
	MIN.	14400	30000	38400	47000	54400		
5th Torquing	1H	16000	32000	41600	[illegible]	57600	67000	
	2H	17000	31400	40600	49000	56400	65000	
	3H	19000	[illegible]	48400	58600	66600	73400	← BOLT HEAD BROKE (SHEAR)
	4H	[illegible]	33000	43400	52400	[illegible]	(92,700 PSI) 62800	← BOLT HEAD BROKE (SHEAR)
	5H	[illegible]	31000	40800	49000	57000	66800	
	AVE.	17440	32840	42960	51800	59680	68050	
	MAX.	19000	37000	42400	58600	66600	73400	
	MIN.	16000	31000	40600	49000	57000	65000	

NON LUBRICATED — TORQUED FROM NUT

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical yield point 130,000 (4)
Initial Torquing	1N	8000	[illegible]	28600	36400	43000	49400	
	2N	11000	20600	[illegible]	[illegible]	52400	[illegible]	
	3N	9600	19000	25400	30800	36800	43600	
	4N	[illegible]	21400	[illegible]	[illegible]	44000	51200	
	5N	8600	18000	26000	[illegible]	[illegible]	41000	
	AVE.	9240	19760	29080	36120	42440	48840	
	MAX.	11000	21400	36000	45400	52400	59000	
	MIN.	8000	18000	25400	30800	36000	41000	
2nd Torquing	1N	10600	20800	27000	33000	38000	43000	
	2N	11000	23000	32400	39600	46200	52800	
	3N	12400	24000	31400	39200	44800	52000	
	4N	12400	26000	34000	41800	48400	55400	
	5N	10000	19600	25600	30800	35000	40200	
	AVE.	11280	22680	30080	36920	42480	48680	
	MAX.	12400	26000	34000	41800	48400	55400	
	MIN.	10000	19600	25600	30800	35000	40200	
3rd Torquing	1N	13000	25000	32600	40000	47000	54600	
	2N	10000	21600	30000	[illegible]	45200	50000	
	3N	13800	26600	34200	43400	51000	59000	
	4N	14200	29000	38600	46600	54600	62000	
	5N	12000	22000	28200	34000	39200	45600	
	AVE.	12600	24840	32720	40200	47000	54240	
	MAX.	14200	29000	38600	46600	54600	62000	
	MIN.	10000	21600	28200	34000	39200	45600	
4th Torquing	1N	13200	26000	[illegible]	[illegible]	51000	59000	
	2N	10400	22000	30000	37000	43400	50800	
	3N	14200	29000	39000	41800	50000	62600	
	4N	16800	34400	45000	53600	61400	70000	
	5N	13400	24800	30200	39000	45000	52000	
	AVE.	13600	27240	35840	44160	50160	58880	
	MAX.	16800	34400	45000	53600	61400	70000	
	MIN.	10400	22000	30000	37000	43400	50800	
5th Torquing	1N	14000	27600	37600	46000	54000	62400	71800 (4)
	2N	9400	22800	31400	38600	44200	51800	61000 (4)
	3N	15000	32000	42800	52000	60000	61200	74800 (4)
	4N	[illegible]	34200	45400	[illegible]	62900	73200	80200 (4)
	5N	14000	26600	33800	41600	48400	55600	63600 (4)
	AVE.	13880	28640	38200	46640	53880	62040	70280
	MAX.	17000	34200	45400	55000	62800	73200	80200
	MIN.	9400	22800	31400	38600	44200	51800	61000

LUBRICATED — TORQUED FROM HEAD

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical yield point 130,000 (4)
Initial Torquing	1H-L	(3) L 2400	5400	8400	11200	14400	18800	
	2H-L	L 2000	4600	6000	9400	[illegible]	17000	
	3H-L	L 1800	4400	7400	10400	14600	[illegible]	
	4H-L	L 2400	5200	7800	11000	14600	19800	
	5H-L	L 2400	5400	8400	11600	15000	19600	
	AVE.	2200	5000	7600	10720	14120	18840	
	MAX.	2400	5400	8400	11600	15000	19800	
	MIN.	1800	4400	6000	9400	12000	17000	
2nd Torquing	1H-L	L 2000	4000	7000	10600	14000	18600	
	2H-L	L 1000	3600	6400	9400	12600	17000	
	3H-L	L 1000	4000	7000	10800	14400	19800	
	4H-L	L 2000	4600	8400	11800	15400	20600	
	5H-L	L 1600	5000	8600	12200	16000	20600	
	AVE.	1520	4240	7480	10960	14480	19320	
	MAX.	2000	5000	8600	12200	16000	20600	
	MIN.	1000	3600	6400	9400	12600	17000	
3rd Torquing	1H-L	L 1400	4400	7000	11400	14800	19600	
	2H-L	L 1200	3800	6200	10000	13600	18600	
	3H-L	L 1000	4600	7600	11000	15000	20000	
	4H-L	L 2000	5000	7800	11400	15400	21000	
	5H-L	L 1400	4600	8000	12000	15800	21200	
	AVE.	1400	4480	7440	11160	14920	20080	
	MAX.	2000	5000	8000	12000	15800	21200	
	MIN.	1000	3800	6200	10000	13600	18600	
4th Torquing	1H-L	L 1000	3600	7000	10800	14600	19800	
	2H-L	L 1400	4800	7600	10600	14600	19600	
	3H-L	L 1000	4200	7800	11800	15800	21000	
	4H-L	L 2000	5000	8200	10400	16800	22600	
	5H-L	L 1000	4400	8000	12000	16400	21400	
	AVE.	1400	4400	7720	11120	15640	20880	
	MAX.	2000	5000	8200	12000	16800	22600	
	MIN.	1000	3600	7000	10400	14600	19600	
5th Torquing	1H-L	L 800	3400	7000	11000	14400	19600	25600 (4)
	2H-L	L 1000	4000	7000	10600	14800	19600	26000 (4)
	3H-L	L 1600	4400	8000	11400	15600	21000	27000 (4)
	4H-L	L 2000	4800	7800	12000	15600	21600	28400 (4)
	5H-L	L 1800	5000	8200	12600	16800	22000	27600 (4)
	AVE.	1440	4320	7600	11520	15440	20760	26920
	MAX.	2000	5000	8200	12600	16800	22000	28400
	MIN.	800	3400	7000	10600	14400	19600	25600

LUBRICATED — TORQUED FROM NUT

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	110,000	Theoretical yield point 130,000 (4)
Initial Torquing	1N-L	(3) L 2000	5200	8400	11600	15600	20000	
	2N-L	L 2400	6000	9000	12600	16000	21400	
	3N-L	L 2800	5400	9000	13600	18400	24000	
	4N-L	L 2000	4600	7600	10400	13400	18000	
	5N-L	L 1800	5800	9000	12400	16000	21000	
	AVE.	2200	5400	8600	12120	15880	20880	
	MAX.	2800	6000	9000	13600	18400	24000	
	MIN.	1800	4600	7600	10400	13400	18000	
2nd Torquing	1N-L	L 1800	5600	9400	13000	17000	22000	
	2N-L	L 2000	4800	8000	12000	16000	21600	
	3N-L	L 2000	5400	10000	14600	19600	25000	
	4N-L	L 1800	4200	7400	10200	14200	18600	
	5N-L	L 1800	5000	8400	11600	16000	21400	
	AVE.	1880	5000	8640	12280	16560	21720	
	MAX.	2000	5600	10000	14600	19600	25800	
	MIN.	1800	4200	7400	10200	14200	18600	
3rd Torquing	1N-L	L 2000	6000	11000	15600	20000	25600	
	2N-L	L 1400	4000	7400	11200	15000	20400	
	3N-L	L 2200	6800	11200	15000	20400	25800	
	4N-L	L 1200	4200	7400	10600	15400	19000	
	5N-L	L 2000	5000	9000	12300	16400	21600	
	AVE.	1760	5200	9200	13040	17440	22480	
	MAX.	2200	6800	11200	15600	20400	25800	
	MIN.	1200	4000	7400	10600	15000	19000	
4th Torquing	1N-L	L 1800	5600	9400	13600	18000	23000	
	2N-L	L 1400	4000	7800	11000	14600	20000	
	3N-L	L 2400	7000	11000	15600	20200	25400	
	4N-L	L 1800	5400	8600	12000	15600	19800	
	5N-L	L 1800	5400	8800	12200	15400	20600	
	AVE.	1840	5480	9120	12880	16760	21760	
	MAX.	2400	7000	11000	15600	20200	25400	
	MIN.	1400	4000	7800	11000	14600	19800	
5th Torquing	1N-L	L 1800	5400	9200	13000	17200	23000	27000 (4)
	2N-L	L 1600	4000	7400	11000	14800	20000	24000 (4)
	3N-L	L 2000	6400	10800	15400	19400	24800	30800 (4)
	4N-L	L 1400	4800	7600	11200	14600	18600	24000 (4)
	5N-L	L 1800	5000	8600	12400	16400	21400	26800 (4)
	AVE.	1600	5120	8720	12600	16480	21560	26520
	MAX.	2000	6400	10800	15400	19400	24800	30800
	MIN.	1400	4000	7400	11000	14600	18600	24000

COMMENTS:
(1) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITIONS WERE TORQUED TO 90,000 PSI ONLY TO PREVENT RUPTURE OR BREAKAGE OF THE RECESSED HEAD SOCKET AND HEX. WRENCH AT VALUES OF TORQUE ABOVE 60,000 IN-LB.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) CALCULATED YIELD POINT OF 140,000 PSI UNATTAINABLE DUE TO LIMITATIONS OF CALIBRATING DEVICES AND TENSION RECORDING INSTRUMENTS.

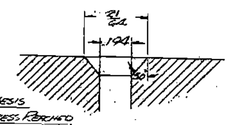
DATE — 9 JANUARY 1957
SIZE — "0" 8-32 NF-3A
SCREW OR BOLT — AN 509 8R-37 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (SLOTTED HEAD)
NUT — AN 365-832 " ELASTIC STOP NUT CORP. UNION, N.J.

TEST CELL — NO.
TORSION — 7B
COMPRESSION — 5A

TEST DATA

CONTRACT NO AF 33(616) 2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

O

NON LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1H	5	14	22	31	43	50	
	2H	5	14	23	32	43	52	
	3H	3	20	29	37	48	NOT ATTEMPTED (2)	
	4H	9	18	27	39	49	"	
	5H	6	13	18	27	29	"	
	AVE.	7	16	24	33	42	51	
	MAX.	9	20	29	39	49	52	
	MIN.	5	13	18	27	29	50	
2nd Torquing	1H	9	22	34	45	52	60	
	2H	10	25	36	48	55	65	
	3H	15	28	40	51	60	NOT ATTEMPTED (2)	
	4H	13	25	38	48	54	"	
	5H	9	19	27	35	46	"	
	AVE.	11	24	35	45	53	63	
	MAX.	15	28	40	51	60	65	
	MIN.	9	19	27	35	46	60	
3rd Torquing	1H	11	25	40	50	57	62	
	2H	11	28	43	55	61 ← SLOT RUPTURED		
	3H	13	29	44	56	64	NOT ATTEMPTED (2)	
	4H	14	25	38	45 ← SLOT SHOWED SIGNS OF RUPTURE		"	
	5H	11	24	35	44	51	"	
	AVE.	12	26	40	50	58		
	MAX.	14	29	44	56	64		
	MIN.	11	24	35	44	51		
4th Torquing	1H	12	28	39	51	61	63	
	2H	13	29	40	50	55	NOT ATTEMPTED (2)	
	3H	10	30	45	59	65	"	
	4H	13	32	44	47	53	"	
	5H	13	27	40	50	60	"	
	AVE.	12	29	42	51	59		
	MAX.	13	32	45	54	65		
	MIN.	10	27	39	47	53		
5th Torquing	1H	12	27	38	51	54 ← SLOT HEAD OF SCREW RUPTURED		
	2H	10	27	40 ← SLOT RUPTURED		TEST DISCONTINUED		
	3H	13	28	44	56 ← SLOT RUPTURED		TEST DISCON.	
	4H	17	29	41	46 ← SLOT RUPTURED		"	"
	5H	15	30	45	54	65	75	(127,500 PSI) 87 SLOT RUPTURED
	AVE.	13	28	42	52	60	75	87
	MAX.	17	30	45	56	65	(ONE SPECIMEN)	(4)
	MIN.	10	27	38	46	54		127,500 psi

NON LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1N	6	12	19	25	32	40	
	2N	9	19	24	30	38	46	
	3N	10	16	22	40	51	NOT ATTEMPTED (1)	
	4N	8	18	28	40	55	" (1)	
	5N	7	17	28	37	47	64	← SCREW BROKE IN SHEAR
	AVE.	8	16	24	34	45	50	
	MAX.	10	19	28	40	55	64	
	MIN.	6	12	19	25	32	40	
2nd Torquing	1N	8	17	25	34	42	49	
	2N	10	25	36	50	59	65	
	3N	12	28	46	59	71	NOT ATTEMPTED (1)	
	4N	14	30	44	57	75	" (1)	
	5N	SCREW BROKE AT 6th PT. OF FIRST TORQUING						
	AVE.	11	25	38	50	62	57	
	MAX.	14	30	46	59	75	65	
	MIN.	8	17	25	34	42	49	
3rd Torquing	1N	7	18	29	37	44	52	
	2N	13	29	45	57	65	74	
	3N	16	37	54	69	76	NOT ATTEMPTED	
	4N	15	37	53	69	87	" (1)	
	5N	TEST DISCONTINUED						
	AVE.	13	30	45	58	68	63	
	MAX.	16	37	54	69	87	74	
	MIN.	7	18	29	37	44	52	
4th Torquing	1N	8	20	33	42	50	55	
	2N	13	32	46	64	74	79	
	3N	18	39	59	74	84	NOT ATTEMPTED (1)	
	4N	16	40	57	80	90	" (1)	
	5N	TEST DISCONTINUED						
	AVE.	14	33	49	65	75	67	
	MAX.	18	40	59	80	90	79	
	MIN.	8	20	33	42	50	55	
5th Torquing	1N	9	21	33	45	54	60	(106,000 PSI) 80
	2N	12	31	50	64	80	88	(106,000 PSI) 91
	3N	16	39	60	75	85	(100,000) 87	← SCREWS BROKE IN SHEAR
	4N	17	38	61	79	(88,300) 84	← SCREW BROKE IN SHEAR	
	5N	TEST DISCONTINUED						
	AVE.	14	32	51	66	73	74	(4) 85.5
	MAX.	17	39	60	79	85	88	91
	MIN.	9	21	33	45	54	60	80

LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1H-L	L (3) 5	7	12	17	24	32	
	2H-L	L 5	9	14	19	25	30	
	3H-L	L 3	6	11	17	27	35	
	4H-L	L 3	7	12	16	27	34	
	5H-L	L 4	9	11	17	22	26	
	AVE.	4	8	12	17	25	31	
	MAX.	5	9	14	19	27	35	
	MIN.	3	6	11	16	22	26	
2nd Torquing	1H-L	5	8	13	17	22	27	
	2H-L	5	9	12	17	22	26	
	3H-L	4	9	14	20	27	34	
	4H-L	4	9	14	20	27	33	
	5H-L	4	9	13	16	21	27	
	AVE.	4	9	13	18	24	29	
	MAX.	5	9	14	20	27	34	
	MIN.	4	8	12	16	21	26	
3rd Torquing	1H-L	4	7	11	15	21	26	
	2H-L	5	10	14	17	23	28	
	3H-L	4	9	15	23	28	32	
	4H-L	4	9	14	20	27	33	
	5H-L	5	9	13	18	22	27	
	AVE.	4	9	13	19	24	29	
	MAX.	5	10	15	23	28	33	
	MIN.	4	7	11	15	21	26	
4th Torquing	1H-L	3	7	11	16	21	27	
	2H-L	5	10	13	17	25	29	
	3H-L	4	10	17	23	28	32	
	4H-L	4	9	15	20	28	33	
	5H-L	5	9	13	17	23	28	
	AVE.	4	9	14	19	25	30	
	MAX.	5	10	17	23	28	33	
	MIN.	3	7	11	16	21	27	
5th Torquing	1H-L	4	8	12	17	23	29	49
	2H-L	5	10	14	18	24	26	31
	3H-L	5	10	16	22	27	31	40
	4H-L	3	9	15	20	27	33	43
	5H-L	5	9	13	17	24	29	39
	AVE.	4	9	14	19	25	30	40
	MAX.	5	10	16	22	27	33	49
	MIN.	3	8	12	17	23	26	31

LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1N-L	L (3) 4	8	13	15	21	23	
	2N-L	L 4	8	11	15	20	25	
	3N-L	L 4	7	10	12	15	18	
	4N-L	L 3	5	10	16	22	25	
	5N-L	L 3	7	11	14	18	22	
	AVE.	4	7	11	14	19	23	
	MAX.	4	8	13	16	22	25	
	MIN.	3	5	10	12	15	18	
2nd Torquing	1N-L	4	7	10	14	17	21	
	2N-L	5	10	12	15	20	25	
	3N-L	4	7	10	13	16	20	
	4N-L	4	7	10	15	19	24	
	5N-L	3	7	10	14	16	20	
	AVE.	4	8	10	14	18	22	
	MAX.	5	10	12	15	20	25	
	MIN.	3	7	10	13	16	20	
3rd Torquing	1N-L	5	10	14	16	19	24	
	2N-L	4	9	13	15	20	24	
	3N-L	4	7	10	14	16	20	
	4N-L	4	5	11	14	19	24	
	5N-L	4	7	10	14	18	20	
	AVE.	4	8	12	15	18	22	
	MAX.	5	10	14	16	20	24	
	MIN.	4	5	10	14	16	20	
4th Torquing	1N-L	5	10	14	16	20	23	
	2N-L	5	8	11	15	20	24	
	3N-L	4	8	11	14	17	20	
	4N-L	4	8	10	15	20	25	
	5N-L	4	8	10	14	18	20	
	AVE.	4	8	11	15	19	22	
	MAX.	5	10	14	16	20	25	
	MIN.	4	8	10	14	17	20	
5th Torquing	1N-L	5	10	15	16	19	22	29
	2N-L	5	9	13	15	19	24	35
	3N-L	4	8	10	15	18	20	29
	4N-L	4	8	13	17	20	25	27
	5N-L	4	9	12	14	19	20	29
	AVE.	4	9	13	15	19	22	30
	MAX.	5	10	15	17	20	25	35
	MIN.	4	8	10	14	18	20	27

COMMENTS:
(1) DUE TO THE BREAKING OF THE SCREWS TORQUED FROM NUT IN DRY CONDITION SPECIMENS 3N THRU 5N WERE STRESSED TO 90,000 PSI ONLY UNTIL 5TH TORQUING. SCREWS BROKE IN SHEAR AT ROOT DIAMETER.
(2) " " " RUPTURING OF THE SLOT HEADS TORQUED FROM THE HEAD END IN DRY CONDITION SPECIMENS 3H THRU 5H WERE STRESSED TO 90,000 PSI ONLY UNTIL 5TH TORQUING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING OF EACH SPECIMEN FOR THE DRY CONDITIONS ONLY DUE TO SCARRING. COUNTERSINK OF HEAD SPACER BLOCK WAS SANDED WITH EMERY CLOTH BY HAND.

PAGE [illegible]

DATE — 27 APRIL 1956

SIZE — "P" 10-32 NF-3A

SCREW OR BOLT — AN 509-10R37 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (PHILLIPS HEAD)

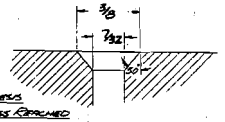
NUT — AN 365-1032 " " ELASTIC STOP NUT CORP., UNION, N.J.

TEST CELL — N9: TORSION — 7B COMPRESSION — 5A

TEST DATA

CONTRACT N° AF 33(616)2808 P-1227

NOTE: FIGURES IN PARENTHESES DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

P

NON LUBRICATED

TORQUED FROM HEAD

TORQUING N°	SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
INITIAL TORQUING	1H	9	20	35	49	65	85	
	2H	9	15	29	34	50	(2)	
	3H	8	25	40	55	70	98	
	4H	12	24	36	54	72	(2)	
	5H	9	18	30	41	56	(2)	
	AVE.	9	20	34	47	63	92	
	MAX.	12	25	40	55	72	98	
	MIN.	8	15	29	34	50	85	
2ND TORQUING	1H	14	35	55	75	96	114	
	2H	13	26	39	50	62	(2)	
	3H	8	19	34	54	85	(2)	
	4H	12	25	37	56	83	(2)	
	5H	10	21	32	46	67	(2)	
	AVE.	11	25	39	56	79		
	MAX.	14	35	55	75	96		
	MIN.	8	19	32	46	62		
3RD TORQUING	1H	15	48	78	96	122	138 (1)	
	2H	13	27	41	53	64	(2)	
	3H	14	26	52	90	115	(2)	
	4H	13	28	41	60	85	(2)	
	5H	11	29	36	51	62	(2)	
	AVE.	13	31	50	71	90		
	MAX.	15	48	78	96	122		
	MIN.	11	24	36	51	62		
4TH TORQUING	1H	RECESSED PHILLIPS HEAD RUPTD. ON TOOL						
	2H	13	30	54	69	86	(2)	
	3H	15	35	61	89	95	(4)	
	4H	15	30	45	64	87	(2)	
	5H	12	29	46	62	72	(2)	
	AVE.	14	31	52	71	85		
	MAX.	15	35	61	89	95		
	MIN.	12	29	45	62	72		
5TH TORQUING	1H							
	2H	16	52	65	88	97	108	(2)
	3H	23	50	80	86	93	101	(122,600 PSI) 103 (2)
	4H	16	34	48	71	96	103	(2)
	5H	18	31	50	69	81	91	HEAD BROKE DURING TORQUE (133,000 PSI) 103
	AVE.	17	42	61	79	92	101	
	MAX.	23	52	80	88	97	108	
	MIN.	12	31	48	69	81	91	

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1N	7	19	30	43	56	66	
2N	8	21	44	67	83	90	
3N	12	20	33	45	70	88	
4N	6	14	26	45	73	96	
5N	11	24	41	74	98	107	
AVE.	9	20	35	55	76	89	
MAX.	12	24	44	74	98	107	
MIN.	6	14	25	43	56	66	
1N	8	20	31	44	54	65	
2N	10	23	41	56	64	70	
3N	10	20	33	52	74	91	
4N	6	19	33	54	85	102	
5N	12	28	52	83	102	106	
AVE.	9	22	38	58	76	87	
MAX.	12	28	52	83	102	106	
MIN.	6	19	31	44	54	65	
1N	10	22	34	48	60	71	
2N	9	22	33	47	61	72	
3N	10	23	36	64	85	102	
4N	7	21	34	57	81	105	
5N	14	29	50	80	104	106	
AVE.	10	23	37	59	78	91	
MAX.	14	29	50	80	104	106	
MIN.	7	21	33	47	60	71	
1N	12	26	40	54	67	78	
2N	10	25	40	53	68	79	
3N	10	25	44	66	86	102	
4N	8	25	45	68	98	113	
5N	14	32	58	89	111	114	
AVE.	11	27	45	66	86	97	
MAX.	14	32	58	89	111	114	
MIN.	8	25	40	53	67	78	
1N	11	27	45	56	67	74	81
2N	11	27	46	55	67	76	83
3N	11	26	45	66	95	110	117
4N	8	29	53	80	110	117	121
5N	14	35	66	101	118	125	134
AVE.	11	29	51	72	91	100	107
MAX.	14	35	66	101	118	125	134
MIN.	8	26	45	55	67	79	81

LUBRICATED

TORQUED FROM HEAD

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1H-L	9	10	17	25	36	47	
2H-L	4	10	20	28	42	48	
3H-L	4	11	17	29	32	36	
4H-L	5	12	18	24	26	29	
5H-L	2	9	17	25	34	42	
AVE.	4	10	18	26	34	40	
MAX.	5	12	20	29	42	48	
MIN.	2	9	17	24	26	29	
1H-L	4	11	17	26	35	49	
2H-L	6	12	14	18	22	27	
3H-L	5	11	17	23	30	35	
4H-L	6	12	17	21	26	30	
5H-L	4	11	19	25	35	42	
AVE.	5	11	17	23	30	37	
MAX.	6	12	19	26	35	49	
MIN.	4	11	14	18	22	27	
1H-L	5	12	20	28	38	50	
2H-L	5	14	20	26	29	31	
3H-L	4	11	17	23	31	36	
4H-L	5	12	18	23	26	31	
5H-L	5	12	20	26	36	43	
AVE.	5	12	19	25	32	38	
MAX.	5	14	20	28	38	50	
MIN.	4	11	17	23	26	31	
1H-L	3	9	15	24	35	42	
2H-L	6	15	29	45	58	61	
3H-L	3	9	14	17	20	24	
4H-L	1	7	12	21	27	33	
5H-L	1	7	14	21	31	39	
AVE.	3	9	17	26	34	40	
MAX.	6	15	29	45	58	61	
MIN.	1	7	12	17	27	24	
1H-L	4	10	18	26	36	43	58
2H-L	4	11	19	31	36	40	45
3H-L	2	7	11	16	21	25	27
4H-L	2	9	15	23	30	36	50
5H-L	2	9	15	23	32	38	54
AVE.	3	9	16	24	31	36	47
MAX.	4	11	19	31	36	43	58
MIN.	2	7	11	16	21	25	27

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1N-L	5	20	25	26	28	33	
2N-L	5	11	17	23	30	39	
3N-L	3	8	16	26	39	47	
4N-L	3	8	13	18	25	35	
5N-L	3	7	13	25	40	46	
AVE.	4	11	17	24	32	40	
MAX.	5	20	25	26	40	47	
MIN.	3	7	13	18	25	33	
1N-L	6	12	17	21	27	31	
2N-L	4	9	14	19	23	37	
3N-L	4	10	19	27	43	48	
4N-L	4	8	14	19	26	35	
5N-L	3	6	13	23	36	40	
AVE.	4	9	15	22	31	38	
MAX.	6	12	19	27	43	48	
MIN.	3	6	13	19	23	31	
1N-L	7	13	18	23	27	31	
2N-L	4	10	15	22	30	38	
3N-L	4	9	16	24	35	41	
4N-L	4	9	13	19	27	35	
5N-L	3	7	14	21	30	39	
AVE.	4	10	15	22	30	37	
MAX.	7	13	18	24	35	41	
MIN.	3	7	13	19	27	31	
1N-L	4	8	12	16	25	36	
2N-L	3	8	14	20	26	39	
3N-L	3	7	13	23	38	44	
4N-L	5	8	19	20	25	29	
5N-L	3	8	15	23	38	46	
AVE.	4	8	15	21	30	39	
MAX.	5	9	19	23	38	46	
MIN.	3	8	12	18	25	29	
1N-L	4	8	12	19	24	35	55
2N-L	4	10	16	22	30	41	64
3N-L	4	8	14	23	36	42	63
4N-L	2	4	10	15	21	26	37
5N-L	2	6	13	18	31	41	43
AVE.	3	7	13	19	28	37	52
MAX.	4	10	16	23	36	42	64
MIN.	2	4	10	15	21	26	37

COMMENTS:

1. BOLT 1H PHILLIPS HEAD RECESS RUPTURED BY DRIVING TOOL AT END OF THIRD TORQUING. TEST ON BOLT WAS DISCONTINUED.
2. SUBSEQUENT BOLTS DRY TORQUED FROM HEAD WERE TORQUED TO VALUES LESS THAN THAT WHICH WOULD RUPTURE THE RECESSED HEADS. HEAD RUPTURES OCCURRED WITH VALUES OF TORQUE IN RANGE OF 100-140 IN-LBS.
3. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
4. SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING OF EACH SPECIMEN FOR THE DRY CONDITIONS ONLY DUE TO STARRINGS. COUNTERSINK OF HEAD SPACER BLOCK WAS SANDED WITH EMERY CLOTH BY HAND.

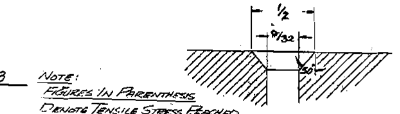
DATE — 23 APRIL 1956
SIZE — "Q" 1/4-28UNF-3A
SCREW OR BOLT — AN 509-416R37 MFTD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (PHILLIPS HEAD)
NUT — AN 365-428 " " ELASTIC STOP NUT CORP., UNION, N. J.

TEST CELL — No.
TORSION — 7B
COMPRESSION — 5A

TEST DATA

CONTRACT No. AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED.



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

Q

NON LUBRICATED

TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Pt. 130,000
Initial Torquing	1H	40	101	136	170	212	(2)	X
	2H	28	52	79	102	141	(2)	X
	3H	28	67	109	167	(2)		X
	4H	31	73	117	160	(2)		X
	5H	30	74	114	110	(2)		X
	AVE.	31	73	111	142	176		
	MAX.	40	101	136	170	212		
	MIN.	28	52	79	102	141		
2nd Torquing	1H	64	144	187	230	(87,400 PSI) 298	← RECESSED HEAD RUPT'D.	X
	2H	32	70	105	140	171		X
	3H	39	91	144	189	(2)		X
	4H	37	89	129	180	(2)		X
	5H	48	93	149	(2)			X
	AVE.	44	97	143	185	213		
	MAX.	64	144	187	230	255 (AVERAGE)		
	MIN.	32	70	105	140	171		
3rd Torquing	1H	RECESSED HEAD RUPTURE ON TOOL - TEST DISCONTINUED						X
	2H	32	77	121	162	189 ← RECESSED HEAD RUPT'D.		X
	3H	39	100	155	148	(2)		X
	4H	39	100	150	(60,500 PSI) 175 ←	RECESSED HEAD RUPTURED BY TOOL		X
	5H	49	104	151	(2)			X
	AVE.	40	95	144	180	189		
	MAX.	49	104	155	195			
	MIN.	32	77	121	162			
4th Torquing	1H	RECESSED HEAD RUPTURE ON TOOL AT END OF 2ND TORQUING.						X
	2H	"	"	" "	" "	" " 3RD	"	X
	3H	42	105	160	202	(2)		X
	4H	RECESSED HEAD RUPTURE ON TOOL DURING 3RD TORQUING.						X
	5H	52	117	167	(2)			X
	AVE.	47	111	164	202			
	MAX.	52	117	167				
	MIN.	42	105	160				
5th Torquing	1H	SEE ABOVE						
	2H	"	"					
	3H	37	103	156	200	265	345	(109,200 PSI) 364 ↑
	4H	SEE ABOVE						RECESSED HEAD RUPT'D
	5H	54	121	175	218	282	320	(2)
	AVE.	46	112	166	209	274	333	(103,300 PSI) 364
	MAX.	54	121	175	218	282	345	
	MIN.	37	103	156	200	265	320	

TORQUED FROM NUT

Tensile Stress (#/in²); all values Torque (in-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Pt. 130,000
Initial Torquing	1N	31	72	119	178	274	323	X
	2N	27	58	106	169	255	(3)	X
	3N	26	70	127	208	297	(3)	X
	4N	68	162	180	190	234	(3)	X
	5N	32	63	96	135	202	(3)	X
	AVE.	37	85	126	176	252		
	MAX.	68	162	180	208	297		
	MIN.	26	63	96	135	202		
2nd Torquing	1N	40	104	169	228	256	256	X
	2N	42	86	150	219	300	(3)	X
	3N	39	94	159	249	330	(3)	X
	4N	65	145	205	250	290	(3)	X
	5N	39	86	125	169	214	(3)	X
	AVE.	45	103	162	223	278		
	MAX.	65	145	205	250	330		
	MIN.	39	86	125	169	214		
3rd Torquing	1N	59	132	200	240	228	176	X
	2N	40	96	160	240	321	(3)	X
	3N	46	128	204	303	361	(3)	X
	4N	67	150	225	273	317	(3)	X
	5N	45	98	145	195	241	(3)	X
	AVE.	50	121	187	250	294		
	MAX.	67	150	225	303	361		
	MIN.	40	96	145	195	228		
4th Torquing	1N	48	122	166	188	201	217	X
	2N	42	107	166	239	310	(3)	X
	3N	52	158	255	351	410	(3)	X
	4N	75	159	230	287	341	(3)	X
	5N	48	117	165	220	275	(3)	X
	AVE.	53	133	196	257	307		
	MAX.	75	159	255	351	410		
	MIN.	42	107	165	188	201		
5th Torquing	1N	51	121	147	181	205	224	(121,200 PSI) 191 BOLT BROKE IN SHEAR
	2N	47	112	177	255	327	175	(3)
	3N	65	180	298	383	426	356	(3)
	4N	72	161	235	291	330	346	(3)
	5N	49	115	176	290	302	375	(3)
	AVE.	57	138	207	270	318	295	(121,200 PSI) 191
	MAX.	72	180	298	383	426	375	
	MIN.	47	112	147	181	205	175	

LUBRICATED

TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Pt. 130,000
Initial Torquing	1H-L	L (5) 16	45	83	107	116	96 (4)	X
	2H-L	L 16	33	48	70	94	125	X
	3H-L	L 13	26	40	56	76	92	X
	4H-L	L 11	28	45	66	87	111	X
	5H-L	L 14	35	57	84	130	143	X
	AVE.	14	33	55	77	101	113	
	MAX.	16	45	83	107	130	143	
	MIN.	11	26	40	56	76	92	
2nd Torquing	1H-L	14	29	44	61	84	111	X
	2H-L	18	35	56	76	104	125	X
	3H-L	11	28	43	60	78	92	X
	4H-L	13	32	51	71	95	123	X
	5H-L	17	36	55	83	116	125	X
	AVE.	15	32	50	70	95	115	
	MAX.	18	36	56	83	116	125	
	MIN.	11	28	43	60	78	92	
3rd Torquing	1H-L	15	32	50	68	91	116	X
	2H-L	17	39	61	82	112	134	X
	3H-L	12	30	49	65	85	100	X
	4H-L	15	35	55	75	103	129	X
	5H-L	17	35	57	85	110	121	X
	AVE.	15	34	54	75	100	120	
	MAX.	17	39	61	85	112	134	
	MIN.	12	30	49	65	85	100	
4th Torquing	1H-L	L 14	29	43	59	75	94	X
	2H-L	L 12	25	39	57	75	92	X
	3H-L	L 10	23	34	50	67	79	X
	4H-L	L 12	29	41	55	73	85	X
	5H-L	L 10	26	42	57	80	97	X
	AVE.	12	26	40	56	74	89	
	MAX.	14	29	43	59	80	97	
	MIN.	10	23	34	50	67	79	
5th Torquing	1H-L	15	30	45	62	82	100	141
	2H-L	13	30	46	63	80	97	145
	3H-L	11	24	39	55	72	86	115
	4H-L	14	30	56	62	79	95	152
	5H-L	12	29	43	60	79	99	137
	AVE.	13	29	46	60	78	95	138
	MAX.	15	30	56	63	82	100	152
	MIN.	11	24	39	55	72	86	115

TORQUED FROM NUT

Tensile Stress (#/in²); all values Torque (in-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Pt. 130,000
Initial Torquing	1N-L	L (6) 10	27	40	56	77	100	X
	2N-L	L 10	25	40	55	72	86	X
	3N-L	L 11	26	46	72	91	107	X
	4N-L	L 11	28	45	70	94	116	X
	5N-L	L 11	25	44	66	93	108	X
	AVE.	11	26	43	64	85	103	
	MAX.	11	28	46	72	94	116	
	MIN.	10	25	40	55	72	86	
2nd Torquing	1N-L	12	31	45	61	78	96	X
	2N-L	11	22	35	50	66	82	X
	3N-L	12	30	54	79	89	101	X
	4N-L	13	31	52	75	105	116	X
	5N-L	13	27	45	60	78	94	X
	AVE.	12	28	46	64	83	98	
	MAX.	13	31	54	75	105	116	
	MIN.	11	22	35	50	66	82	
3rd Torquing	1N-L	12	33	51	65	85	103	X
	2N-L	11	24	39	55	72	89	X
	3N-L	13	34	56	77	93	105	X
	4N-L	13	33	50	76	109	121	X
	5N-L	14	31	49	70	84	100	X
	AVE.	13	31	49	69	89	104	
	MAX.	14	34	56	77	109	121	
	MIN.	11	24	39	55	72	89	
4th Torquing	1N-L	L 10	25	40	55	73	90	X
	2N-L	L 9	20	34	50	67	81	X
	3N-L	L 10	25	47	73	121	143	X
	4N-L	L 11	26	44	65	97	115	X
	5N-L	L 10	25	41	69	100	107	X
	AVE.	10	24	41	62	92	107	
	MAX.	11	26	47	73	121	143	
	MIN.	9	20	34	50	67	81	
5th Torquing	1N-L	12	29	45	64	79	98	140
	2N-L	10	22	36	51	71	86	120
	3N-L	12	34	55	75	100	111	124
	4N-L	13	31	52	77	105	121	150?
	5N-L	13	39	51	75	100	113	122?
	AVE.	12	31	48	68	91	106	13[illegible]
	MAX.	13	39	55	77	105	121	150?
	MIN.	10	22	36	51	71	86	120

COMMENTS:
1. PHILLIPS HEADS OF BOLTS 1H THRU 5H RUPTURED BY TOOL AS NOTED ABOVE. RUPTURE OCCURRED IN TORQUE RANGE OF 175-350 IN LB.
2. RUN DISCONTINUED TO PREVENT RUPTURE OF PHILLIPS SOCKET HEAD.
3. RUN DISCONTINUED TO PREVENT BREAKAGE OF BOLT IN SHEAR AT ROOT DIAMETER.
4. BOLT 1H-L MAY HAVE OVERCOME A BEARING SURFACE ON DIRECTED BURR DURING INITIAL TORQUING BETWEEN 5TH & 6TH POINT.
5. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF EACH TORQUING FOR INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
6. SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING OF EACH SPECIMEN FOR DRY CONDITIONS ONLY DUE TO SCARRING. COUNTERSINK OF HEAD SPACER BLOCK WAS SANDED WITH EMERY CLOTH BY HAND.

PAGE [illegible]

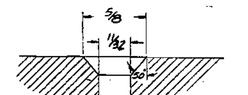
DATE — 14 JANUARY 1957
SIZE — "R" 5/16-24UNF-3A
SCREW OR BOLT — AN 509-516R48 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (SLOT HEAD)
NUT — AN 365-524 MFD. BY ELASTIC STOP NUT CORP. UNION, NEW JERSEY

TEST CELL — NO.
TORSION — 7B
COMPRESSION — 5B

TEST DATA

CONTRACT NO AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

R

NON LUBRICATED — TORQUED FROM HEAD

Tensile stress (#/in²); torque values in in.-#

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1H	33	91	149	227	295	367	
	2H	50	85	195	278	356	(1)	
	3H	34	91	144	196	253	(1)	
	4H	106	134	217	315	392	(1)	
	5H	66	165	249	340	425	(1)	
	AVE.	58	113	191	271	344		
	MAX.	106	165	249	340	425		
	MIN.	33	85	144	196	253		
2nd Torquing	1H	99	230	304	390	445	490	
	2H	102	222	310	399	461	(1)	
	3H	70	163	222	279	329	(1)	
	4H	131	290	395	485	(1)		
	5H	125	285	386	468	(1)		
	AVE.	105	238	323	404	411		
	MAX.	131	290	395	485	461		
	MIN.	70	163	222	279	329		
3rd Torquing	1H	110	260	360	448	503	505	
	2H	106	261	386	454 ← SLOT RUPTURED			
	3H	94	200	275	338	(1)		
	4H	141	348	470	540	(1)		
	5H	145	315	438	510	(1)		
	AVE.	119	277	386	458			
	MAX.	145	348	470	540			
	MIN.	94	200	275	338			
4th Torquing	1H	96 ← SLOT RUPTURED						
	2H	(2) 135	300	385 ← SLOT RUPTURED				
	3H	105	288	331	404	(1)		
	4H	150	352	490	592	(1)		
	5H	147	342	457	552	(1)		
	AVE.	127	321	416	516			
	MAX.	150	352	490	592			
	MIN.	96	288	331	404			
5th Torquing	1H	TEST	DISCONTINUED					
	2H	"	"					
	3H	107	257	373	456	507 ← SLOT RUPTURED		SLOT RUPTURED
	4H	150	370	505	610	688	712	(115,000 PSI) 719
	5H	143	335	478	572	635	680	(115,500 PSI) 700
	AVE.	133	321	452	546	610	696	
	MAX.	150	370	505	610	688	712	
	MIN.	107	257	379	456	507	680	

NON LUBRICATED — TORQUED FROM NUT

Tensile stress (#/in²); torque values in in.-#

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1N	40	82	132	198	290	357	
	2N	30	68	111	157	222	286	
	3N	46	84	130	188	274	482	
	4N	40	80	125	176	228	298	
	5N	36	83	128	175	254	335	
	AVE.	38	79	125	179	254	352	
	MAX.	46	84	132	198	290	482	
	MIN.	30	68	111	157	222	286	
2nd Torquing	1N	96	211	291	371	435	481	
	2N	46	146	234	307	374	431	
	3N	96	250	355	453	535	595	
	4N	60	132	198	275	345	407	
	5N	75	207	301	387	465	539	
	AVE.	75	189	276	359	431	491	
	MAX.	96	250	355	453	535	595	
	MIN.	46	132	198	275	345	407	
3rd Torquing	1N	110	240	352	437	506	556	
	2N	75	195	288	382	456	506	
	3N	110	265	390	500	578	631	
	4N	71	175	285	370	443	502	
	5N	87	233	331	458	549	613	
	AVE.	91	222	329	429	506	562	
	MAX.	110	265	390	500	578	631	
	MIN.	71	175	285	370	443	502	
4th Torquing	1N	117	261	379	479	542	587	
	2N	100	265	376	480	552	603	
	3N	110	278	397	500	582	625	
	4N	93	237	334	447	524	591	
	5N	90	245	358	473	557	620	
	AVE.	102	257	369	476	551	605	
	MAX.	117	278	397	500	582	625	
	MIN.	90	237	334	447	524	587	BOLT YIELDED ↓
5th Torquing	1N	97	270	363	445	508	545	(116,400 PSI) 600
	2N	106	275	385	482	561	624	(113,000 PSI) 640
	3N	105	268	382	471	548	597	(119,200 PSI) 607
	4N	100	250	362	478	567	629	(117,000 PSI) 658
	5N	90	240	372	485	584	646	(112,100 PSI) 650
	AVE.	100	261	373	472	554	608	(115,540 PSI) 631
	MAX.	106	275	385	485	584	646	
	MIN.	90	240	362	445	508	545	

LUBRICATED — TORQUED FROM HEAD

Tensile stress (#/in²); torque values in in.-#

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1H-L	L (3) 35	71	105	139	167	190	
	2H-L	L 21	45	71	99	127	153	
	3H-L	L 22	46	60	88	123	164	
	4H-L	L 20	43	60	73	94	108	
	5H-L	L 25	47	65	82	106	135	
	AVE.	25	50	72	96	123	150	
	MAX.	35	71	105	139	167	190	
	MIN.	20	43	60	73	94	108	
2nd Torquing	1H-L	40	97	133	166	193	218	
	2H-L	21	51	83	116	146	175	
	3H-L	26	51	76	106	139	170	
	4H-L	21	44	60	76	96	120	
	5H-L	24	47	67	95	125	150	
	AVE.	26	58	84	112	140	167	
	MAX.	40	97	133	166	193	218	
	MIN.	21	44	60	76	96	120	
3rd Torquing	1H-L	L 22	58	72	98	126	151	
	2H-L	23	60	93	130	162	186	
	3H-L	L 20	49	76	110	140	166	
	4H-L	L 23	42	65	94	113	140	
	5H-L	L 15	35	56	85	116	160	
	AVE.	21	49	72	103	131	161	
	MAX.	23	60	93	130	162	186	
	MIN.	15	35	56	85	113	140	
4th Torquing	1H-L	27	63	92	121	146	170	
	2H-L	L 15	41	64	96	126	158	
	3H-L	25	53	81	110	140	162	
	4H-L	20	47	75	105	129	150	
	5H-L	24	57	78	111	142	176	
	AVE.	22	53	78	109	137	163	
	MAX.	27	63	92	121	146	176	
	MIN.	15	41	64	96	126	150	
5th Torquing	1H-L	38	86	120	159	181	213	307
	2H-L	21	47	72	104	139	168	241
	3H-L	25	61	91	124	151	176	(127,000 PSI) 230 BOLT YIELDED
	4H-L	L 20	44	71	96	124	143	205
	5H-L	15	45	78	111	143	169	(123,600 PSI) 193 BOLT YIELDED
	AVE.	24	57	86	119	148	174	251
	MAX.	38	86	120	159	181	213	307
	MIN.	15	44	71	96	124	143	205

LUBRICATED — TORQUED FROM NUT

Tensile stress (#/in²); torque values in in.-#

Torquing No.	Specimen No.	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1N-L	L (3) 21	43	65	95	120	132	
	2N-L	L 19	43	72	95	121	129	
	3N-L	L 19	36	55	78	108	133	
	4N-L	L 16	35	56	80	111	146	
	5N-L	L 17	40	58	89	125	157	
	AVE.	18	39	61	87	117	139	
	MAX.	21	43	72	95	125	157	
	MIN.	16	35	55	78	108	129	
2nd Torquing	1N-L	26	53	80	104	121	128	
	2N-L	24	44	71	95	119	134	
	3N-L	15	39	55	75	106	132	
	4N-L	20	45	71	101	127	155	
	5N-L	21	46	68	94	122	143	
	AVE.	21	45	69	94	119	138	
	MAX.	26	53	80	104	127	155	
	MIN.	15	39	55	75	106	128	
3rd Torquing	1N-L	28	57	82	106	125	137	
	2N-L	24	50	70	96	120	138	
	3N-L	18	45	66	90	113	130	
	4N-L	24	57	91	117	150	170	
	5N-L	21	46	70	104	132	160	
	AVE.	23	51	76	103	128	147	
	MAX.	28	57	91	117	150	170	
	MIN.	18	45	66	90	113	130	
4th Torquing	1N-L	31	60	85	107	129	141	
	2N-L	30	53	80	104	127	141	
	3N-L	16	46	75	100	125	141	
	4N-L	21	66	102	131	163	188	
	5N-L	24	51	82	106	139	165	
	AVE.	24	55	85	110	137	155	
	MAX.	31	66	102	131	163	188	
	MIN.	16	46	75	100	125	141	
5th Torquing	1N-L	31	64	92	113	133	153	(108,000 PSI) 253 HEAD YIELDED
	2N-L	28	56	80	106	130	145	(125,000 PSI) 205 BOLT YIELDED
	3N-L	22	53	83	104	135	156	(128,000 PSI) 200 BOLT YIELDED
	4N-L	28	76	110	143	175	198	234
	5N-L	23	52	78	106	135	160	199
	AVE.	26	60	89	114	142	162	216
	MAX.	31	76	110	143	175	198	234
	MIN.	22	52	78	104	130	145	199

COMMENTS:
(1) DUE TO THE SCREW DRIVER BLADE RUPTURING THE HEAD OF THE SCREWS (TORQUED FROM THE HEAD) IN THE DRY CONDITION SPECIMENS WERE TORQUED TO TENSILE STRESSES LESS THAN THAT CAUSING RUPTURE UNTIL 5TH TORQUING.
(2) 4TH TORQUING WAS ATTEMPTED EVEN THOUGH SLOT HAD RUPTURED OUT AT END OF 3RD TORQUING OF SCREW SPECIMEN 2H.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) SPACER BLOCKS WERE SANDED AFTER 5TH TORQUING OF EACH SPECIMEN FOR DRY CONDITIONS ONLY DUE TO SCARRING. COUNTERSINK OF HEAD SPACER BLOCK WAS SANDED WITH EMERY CLOTH BY HAND.

PAGE 1A
EK

WADC TR 57-330

105

DATE — 1 MAY 1956

SIZE — S 3/8-24 UNF-3A

SCREW OR BOLT — AN 509-616 R48 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (PHILLIPS HEAD)

NUT — AN 365-624 " " ELASTIC STOP NUT CORP., UNION, N.J.

TEST CELL — N°.

TORSION — JAE 78

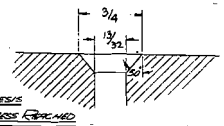
COMPRESSION — 58

TEST DATA

CONTRACT N° AF 33(616)2808

P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL C - SCALE 60)

S

NON LUBRICATED

TORQUED FROM HEAD

TORQUING N°	SPECIMEN N°	10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
INITIAL TORQUING	1H	100	275	455	610 ← RECESSED HEAD RUPTURED ON TOOL	(3)		
	2H	110	305	495	625 ← "	"		
	3H	95	260	425	560 (3)			
	4H	100	285	480	(3)			
	5H	90	230	400	(3)			
	AVE.	99	271	451	598			
	MAX.	110	305	495	625			
	MIN.	90	230	400	560			
2ND TORQUING	1H	TEST DISCONTINUED						
	2H	"	"					
	3H	205	470	(3)				
	4H	210	510	(3)				
	5H	175	415	(3)				
	AVE.	197	465					
	MAX.	210	510					
	MIN.	175	415					
3RD TORQUING	1H	TEST DISCONTINUED						
	2H	"	"					
	3H	210	500	(3)				
	4H	245	550	(3)				
	5H	200	475	(3)				
	AVE.	218	508					
	MAX.	245	550					
	MIN.	200	475					
4TH TORQUING	1H	TEST DISCONTINUED						
	2H	"	"					
	3H	225	545	(3)				
	4H	225	550	(3)				
	5H	220	520	(3)				
	AVE.	223	538					
	MAX.	225	550					
	MIN.	220	520					
5TH TORQUING	1H	TEST DISCONTINUED						
	2H	"	"					
	3H	225	550	(40,400 PSI) 623 ← RECESSED HEAD RUPTURED (PHILLIPS #3) (3)				BY TOOL
	4H	225	625	← "	"	"	"	
	5H	230	560 ← TOOL BROKE OFF IN RECESSED HEAD					
	AVE.	227	578					
	MAX.	230	625					
	MIN.	225	550					

TORQUED FROM NUT

SPECIMEN N°	10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1N	60	140	260	387	502	585	
2N	83	210	300	394	512	634	
3N	108	310	525	704	868	(1)	
4N	70	182	305	455	625	(1)	
5N	80	215	335	495	650	(1)	
AVE.	80	211	345	483	631		
MAX.	108	310	525	704	868		
MIN.	60	140	260	387	502		
1N	127	325	590	780	947	(1)	
2N	140	363	520	662	802	(1)	
3N	185	497	750	944	1100	(1)	
4N	195	395	600	795	1000	(1)	
5N	175	405	625	830	1075	(1)	
AVE.	164	397	617	802	985		
MAX.	195	497	750	944	1100		
MIN.	127	325	520	662	802		
1N	210	510	740	900	1032	(1)	
2N	140	435	640	825	982	(1)	
3N	215	535	812	1025	1202	(1)	
4N	185	470	720	950	1210	(1)	
5N	190	525	760	950	(85,400 PSI) 1205 ← BOLT YIELDED		
AVE.	188	495	734	930	1106		
MAX.	215	535	812	1025	1210		
MIN.	140	435	640	825	982		
1N	225	533	767	950	1090	(1)	
2N	160	473	684	880	1098	(1)	
3N	170	450	675	850	1008	(1)	
4N	165	490	795	1045	1205	(1)	
5N	BOLT YIELDED AT END OF 3RD TORQUING						
AVE.	180	486	730	931	1088		
MAX.	225	533	795	1045	1205		
MIN.	160	450	675	850	1008		
1N	210	550	785	950	1087	(90,200 PSI) 1093	
2N	175	465	690	879	1050	(94,100 PSI) 1125	
3N	165	500	740	905	1115	(90,000 PSI) 1215	
4N	200	500	770	1040	1210	(91,300 PSI) 1215	BOLTS 1 & 4 YIELDED
5N	TEST DISCONTINUED AT 3RD TORQUING						
AVE.	188	504	746	944	1116	(91,800 PSI) 1117	
MAX.	210	550	785	1040	1210		
MIN.	165	465	690	879	1050		

LUBRICATED

TORQUED FROM HEAD

SPECIMEN N°	10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1H-L	(35°) 50	102	141	177	232	291	
2H-L	(38) 52	92	145	210	292	348	
3H-L	(35) 48	133	215	232	254	285	
4H-L	(43) 59	125	209	297	304	335	
5H-L	(34) 47	76	135	210	304	375	
AVE.	40	106	169	225	277	327	
MAX.	50	133	215	297	304	375	
MIN.	34	76	135	177	232	285	
1H-L	47	105	149	199	266	335	
2H-L	41	93	146	217	293	353	
3H-L	40	90	137	186	236	280	
4H-L	47	110	160	217	263	304	
5H-L	39	90	152	224	308	352	
AVE.	43	98	149	209	273	325	
MAX.	47	110	160	224	308	353	
MIN.	39	90	137	186	236	280	
1H-L	48	101	152	215	287	340	
2H-L	(62) 52	121	160	162	205	231	
3H-L	43	106	155	205	258	300	
4H-L	(28) 40	70	110	160	212	252	
5H-L	(20) 40	54	107	175	256	330	
AVE.	40	90	137	183	244	291	
MAX.	62	121	160	215	287	340	
MIN.	20	54	107	160	205	231	
1H-L	(27) 36	65	105	156	225	287	
2H-L	38	77	117	160	204	242	
3H-L	(20) 30	52	97	148	195	238	
4H-L	35	85	137	190	237	279	
5H-L	30	73	127	185	279	341	
AVE.	30	70	117	169	228	277	
MAX.	38	85	137	195	277	341	
MIN.	20	52	97	145	195	238	
1H-L	36	135	129	130	250	313	(130,200 PSI) 454 (2)
2H-L	42	87	131	177	227	262	(123,500 PSI) 312 (2)
3H-L	35	82	125	174	227	270	(123,350 PSI) 320 (2)
4H-L	(28) 63	104	152	205	245		(123,200 PSI) 306 (2)
5H-L	(20) 53	104	168	255	340		(123,350 PSI) 325 (2)
AVE.	44	84	119	160	233	286	(129,350 PSI) 478
MAX.	42	135	131	177	255	340	
MIN.	20	53	104	130	205	245	

TORQUED FROM NUT

SPECIMEN N°	10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1N-L	(28) 40	78	125	167	205	236	
2N-L	(31) 44	75	126	178	252	292	
3N-L	(29) 41	117	160	201	239	255	
4N-L	(37) 52	84	136	195	251	284	
5N-L	(30) 43	78	128	180	249	305	
AVE.	31	86	135	184	238	272	
MAX.	37	117	160	201	252	305	
MIN.	28	75	125	167	205	236	
1N-L	43	100	144	175	220	247	
2N-L	48	107	162	216	259	292	
3N-L	49	107	145	179	211	232	
4N-L	42	100	155	202	241	272	
5N-L	46	105	154	207	272	330	
AVE.	46	104	152	196	241	275	
MAX.	49	107	162	216	272	330	
MIN.	42	100	144	175	211	232	
1N-L	56	112	160	197	236	267	
2N-L	53	115	171	232	284	327	
3N-L	60	113	152	182	212	242	
4N-L	45	101	146	224	278	311	
5N-L	55	126	185	245	310	371	
AVE.	54	113	167	216	264	304	
MAX.	60	126	185	245	310	371	
MIN.	45	101	152	182	212	242	
1N-L	(19) 24	64	125	175	225	264	
2N-L	(24) 30	63	124	190	252	296	
3N-L	(24) 30	60	107	169	237	290	
4N-L	(25) 31	70	121	175	225	265	
5N-L	(27) 34	71	135	199	279	332	
AVE.	24	66	122	181	244	289	
MAX.	27	71	135	199	279	332	
MIN.	19	60	107	164	225	264	
1N-L	96	107	152	197	242	282	330
2N-L	52	106	167	224	278	317	365
3N-L	45	97	149	198	274	330	380
4N-L	40	84	132	131	236	278	419
5N-L	48	169	172	245	310	358	505
AVE.	46	101	153	199	268	313	400
MAX.	52	109	172	245	310	352	505
MIN.	40	84	132	131	236	278	330

COMMENTS:
1. BOLTS IN 1HRU 5N DISPLAYED TENDENCY TO YIELD AT STRESSES GREATER THAN 90,000 PSI. BOLTS WERE TORQUED TO 90,000 PSI ONLY TO PREVENT YIELDING PRIOR TO 5TH TORQUING.
2. BOLTS 2H-L TO 5H-L YIELDED PRIOR TO ATTAINING THEORETICAL YIELD POINT.
3. BOLTS IN 1HRU 5N RECESSED PHILLIPS (#4) HEADS RUPTURED AT VALUES OF TORQUE IN RANGE OF 575-625 IN-LB. BOLTS 3H THRU 5H WERE TORQUED TO VALUES LESS THAN THOSE CAUSING HEAD RUPTURE PRIOR TO 5TH TORQUING.
4. LUBRICATED HUNG A&E WASHERS MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
5. SPACER BLOCKS WERE SANDED AFTER 5TH TORQUING OF EACH SPECIMEN FOR DRY CONDITIONS ONLY DUE TO SCARRING. COUNTERSINK OF HEAD SPACER BLOCK WAS SANDED WITH EMERY CLOTH BY HAND.

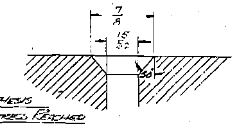
DATE — 17 JANUARY '57
SIZE — "T" 7/16-20UNF-3A
SCREW OR BOLT — AN509-716R48 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (FREARSON HEAD)
NUT — AN365-720 MFD. BY ELASTIC STOP NUT CORP., UNION, N. J.

TEST CELL — №
TORSION — 7A & 7B
COMPRESSION — 5B

TEST DATA

CONTRACT № AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

T

NON LUBRICATED — TORQUED FROM HEAD

Torquing №	Specimen №	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1H	145	350	640	840	(88,250 PSI) 1000 ← HEAD RUPTURED		X
	2H	165	390	(44,400 PSI) 620 ← HEAD RUPTURED				X
	3H	160	415	(1)				X
	4H	180	550	(1)				X
	5H	225	585	(1)				X
	AVE.	175	458					
	MAX.	225	585					
	MIN.	145	350					
2nd Torquing	1H	TEST	DISCONTINUED					X
	2H	"	"					X
	3H	255	570	(1)				X
	4H	315	665	(1)				X
	5H	340	770	(1)				X
	AVE.	303	668					
	MAX.	340	770					
	MIN.	255	570					
3rd Torquing	1H							X
	2H							X
	3H	310	(22,900 PSI) 555 ← HEAD RUPTURED					X
	4H	305	(1)					X
	5H	410	(1)					X
	AVE.	342						
	MAX.	410						
	MIN.	305						
4th Torquing	1H							X
	2H							X
	3H	250	(1)					X
	4H	300	(1)					X
	5H	425	(1)					X
	AVE.	325						
	MAX.	425						
	MIN.	250						
5th Torquing	1H							
	2H							
	3H	300	(27,500 PSI) 580 ← HEAD RUPTURED					
	4H	325	(16,100 PSI) 480 ← HEAD RUPTURED					
	5H	430	860	(30,500 PSI) 875 ← HEAD RUPTURED				
	AVE.	352						
	MAX.	430						
	MIN.	300						

NON LUBRICATED — TORQUED FROM NUT

Torquing №	Specimen №	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1N	175	425	690	910	1360		X
	2N	215	540	905	1090	1275		X
	3N	200	490	750	1010	1355		X
	4N	205	470	715	1115	1305		X
	5N	125	332	590	840	1121		X
	AVE.	184	451	730	999	1283		
	MAX.	215	540	905	1115	1360		
	MIN.	125	332	590	840	1121		
2nd Torquing	1N	315	700	1010	1250	1495		X
	2N	330	815	1045	1270	1445		X
	3N	275	675	1000	1250	1470		X
	4N	225	700	960	1210	1515		X
	5N	340	530	890	1215	(2)		X
	AVE.	297	684	981	1239	1481		
	MAX.	340	815	1045	1270	1515		
	MIN.	225	530	890	1210	1445		
3rd Torquing	1N	375	790	1125	1395	1645		X
	2N	375	820	1125	1440	1600		X
	3N	375	755	1170	1305	1495		X
	4N	300	690	1040	1300	1590		X
	5N	315	745	1265	1435	(2)		X
	AVE.	348	760	1145	1375	1580		
	MAX.	375	820	1265	1440	1645		
	MIN.	300	690	1040	1300	1485		
4th Torquing	1N	325	770	1140	1445	1725		X
	2N	355	765	1090	1320	1535		X
	3N	375	775	1030	1270	1470		X
	4N	300	715	1065	1380	1655		X
	5N	375	885	1225	1565	(2)		X
	AVE.	346	782	1110	1396	1596		
	MAX.	375	885	1225	1565	1725		
	MIN.	300	715	1030	1270	1470		
5th Torquing	1N	325	790	1145	1485	1750	1825 ← BOLT YIELDED	
	2N	320	755	1100	1350	1545	(101,900 PSI) 1840 ← "	
	3N	340	735	1035	1300	1535	(99,200 PSI) 1750 ← "	
	4N	300	750	1125	1390	1665	(92,800 PSI) 1675 ← "	
	5N	450	875	1140	1140 (2) ← BOLT YIELDED			
	AVE.	347	781	1109	1333	1624		
	MAX.	450	875	1145	1485	1750		
	MIN.	300	735	1035	1140	1535		

(Written vertically in the 105,000 column, Initial through 4th Torquing:) 4TH POINT OF TENSILE STRESS NOT ATTEMPTED TO PREVENT BOLTS YIELDING PRIOR TO 5TH TORQUING

LUBRICATED — TORQUED FROM HEAD

Torquing №	Specimen №	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1H-L	(3) L 90	168	230	285	333	390	X
	2H-L	L 87	167	240	289	332	396	X
	3H-L	L 75	165	240	305	360	417	X
	4H-L	L 79	175	268	350	414	475	X
	5H-L	L 71	137	198	281	384 ← SLOT RUPTURED		X
	AVE.	80	162	235	300	365	420	
	MAX.	90	175	268	350	414	475	
	MIN.	71	137	198	281	332	390	
2nd Torquing	1H-L	74	144	203	268	336	407	X
	2H-L	87	157	223	273	351	431	X
	3H-L	77	167	235	300	375	420	X
	4H-L	96	166	219	283	361	442	X
	5H-L	TEST	DISCONTINUED					X
	AVE.	84	159	220	281	356	425	
	MAX.	96	167	235	300	375	442	
	MIN.	74	144	203	268	336	407	
3rd Torquing	1H-L	70	150	215	286	363	427	X
	2H-L	86	173	296	322	393	460	X
	3H-L	85	178	250	315	392	445	X
	4H-L	93	175	240	299	375	454	X
	5H-L							X
	AVE.	84	169	250	306	381	447	
	MAX.	93	178	296	322	393	460	
	MIN.	70	150	215	286	363	427	
4th Torquing	1H-L	75	160	220	307	383	456	X
	2H-L	L 48	95	159	218	287	361	X
	3H-L	L 38	96	162	240	319	387	X
	4H-L	L 60	145	195	260	332	390	X
	5H-L							X
	AVE.	55	124	186	256	332	399	BOLTS YIELDED ↓
	MAX.	75	160	220	307	388	456	
	MIN.	38	95	159	218	287	361	
5th Torquing	1H-L	L 42	93	152	232	313	375	(127,800 PSI) 575
	2H-L	75	147	201	267	340	403	(119,500 PSI) 537
	3H-L	56	135	206	280	358	415	(125,000 PSI) 528
	4H-L	76	156	209	262	342	415	(116,000 PSI) 420
	5H-L							
	AVE.	62	133	192	260	338	402	
	MAX.	76	156	209	280	358	415	
	MIN.	42	93	152	232	313	375	

LUBRICATED — TORQUED FROM NUT

Torquing №	Specimen №	10,000 Torque (in.-#)	30,000 Torque (in.-#)	50,000 Torque (in.-#)	70,000 Torque (in.-#)	90,000 Torque (in.-#)	105,000 Torque (in.-#)	Theoretical Yield Pt. 130,000 Torque (in.-#)
Initial Torquing	1N-L	(3) L 55	120	190	280	355	425	X
	2N-L	L 57	122	196	275	352	426	X
	3N-L	L 50	120	190	265	347	419	X
	4N-L	L 64	141	221	292	344	397	X
	5N-L	L 60	146	206	277	360	472	X
	AVE.	57	130	201	276	352	428	
	MAX.	64	146	221	292	360	472	
	MIN.	50	120	190	265	344	397	
2nd Torquing	1N-L	35	73	110	141	175	200	X
	2N-L	40	77	108	141	171	202	X
	3N-L	60	153	230	300	378	442	X
	4N-L	65	142	221	291	353	405	X
	5N-L	85	171	243	317	396	491	X
	AVE.	57	124	182	238	295	348	
	MAX.	85	177	243	317	396	491	
	MIN.	35	73	108	141	171	200	
3rd Torquing	1N-L	37	77	115	150	181	210	X
	2N-L	41	85	123	151	185	219	X
	3N-L	90	190	275	345	410	478	X
	4N-L	90	169	243	315	392	441	X
	5N-L	L 53	125	182	256	331	450	X
	AVE.	62	129	188	243	298	360	
	MAX.	90	190	275	345	410	478	
	MIN.	37	77	115	150	181	210	
4th Torquing	1N-L	38	80	118	152	187	217	X
	2N-L	45	95	130	165	198	223	X
	3N-L	L 44	113	185	249	315	380	X
	4N-L	L 48	115	180	252	325	393	X
	5N-L	83	164	238	307	400	525	X
	AVE.	52	113	170	225	285	348	
	MAX.	83	164	238	307	400	525	
	MIN.	38	80	118	152	187	217	
5th Torquing	1N-L	42	91	130	165	205	230	285
	2N-L	49	148	210	290	359	431	(111,[illegible] PSI) 525
	3N-L	78	160	235	303	380	447	[illegible]
	4N-L	70	146	214	281	345	407	[illegible]
	5N-L	L 63	126	185	242	320 ← BOLT YIELDED		
	AVE.	60	134	195	256	322	379	
	MAX.	78	160	235	303	380	[illegible]	
	MIN.	42	91	130	165	205	230	

COMMENTS:
(1) TO PREVENT RUPTURE OF THE FREARSON HEAD BY THE TOOL WHEN TORQUING FROM THE HEAD IN THE DRY CONDITION SPECIMENS WERE NOT TORQUED ABOVE VALUES SHOWN.
(2) 90,000 PSI POINT NOT ATTEMPTED DUE TO SLIGHT INDICATION OF BOLT YIELDING BEYOND 70,000 PSI ON SPECIMEN 5N.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING OF EACH SPECIMEN FOR THE DRY CONDITIONS ONLY DUE TO SCARRING. COUNTERSINK OF HEAD BLOCK WAS SANDED WITH EMERY CLOTH BY HAND.

WADC TR 57-330

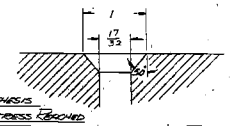
107

DATE — 21 JANUARY 1957
SIZE — "U" 1/2-20UNF-3A
SCREW OR BOLT — AN 509-816R49 MFTD BY AERO BOLT & SCREW CO., STAMFORD, CONN. (SLOT HEAD)
NUT — AN 365-820 MFTD BY ELASTIC STOP NUT CORP., UNION, NEW JERSEY

TEST CELL — No.
TORSION — 7A&7B
COMPRESSION — 5B

TEST DATA
CONTRACT No. AF 33(616)2806
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

U

NON LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	105,000 TORQUE (in-#)	THEORETICAL YIELD PT. 130,000 TORQUE (in-#)
INITIAL TORQUING TORQUING No.							
1H	200	555	875	1235	(80,000 PSI) 1650 ← TOOL BROKE		
2H	180	440	690	945	1300	(1)	
3H	300	655	1030	TOOL BROKE			
4H	190	430	690	(1)			
5H	(2)						
AVE.	218	520	836	1090	>1475		
MAX.	300	655	1090	1235	>1650		
MIN.	180	430	690	945	1300		
2ND TORQUING							
1H	470	1040	1500	(53,000 PSI) 1725 ← TOOL BROKE			
2H	430	935	1350	(1)			
3H	550	1200	(1)				
4H	350	700	(1)				
5H							
AVE.	450	969	1425				
MAX.	550	1200	1500				
MIN.	350	700	1350				
3RD TORQUING							
1H	490	1200	(1)				
2H	465	1100	(1)				
3H	625	1280	(1)				
4H	370	799	← TOOL BROKE. TEST DISCONTINUED				
5H							
AVE.	488	1095					
MAX.	625	1280					
MIN.	370	799					
4TH TORQUING							
1H	525	1130	(1)				
2H	505	1140	(1)				
3H	640	(82,500 PSI) 1235	← TOOL BROKE (NOT AVERAGED)				
4H							
5H							
AVE.	556	1135					
MAX.	640	1140					
MIN.	505	1130					
5TH TORQUING							
1H	515	1185	(1)				
2H	500	1245	(1)				
3H	665	(94,500 PSI) 1250	← TOOL BROKE (NOT AVERAGED)				
4H							
5H							
AVE.	560	1215					
MAX.	665	1245					
MIN.	500	1185					

TORQUED FROM NUT

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	105,000 TORQUE (in-#)	THEORETICAL YIELD PT. 130,000 TORQUE (in-#)
1N	180	420	675	975	1310	1560	
2N	350	785	1320	1850	2315	2625	
3N	370	835	1240	1640	2010	2355	
4N	295	675	1050	1370	1740	2105	
5N	230	550	890	1210	1615	1950	
AVE.	285	653	1035	1409	1798	2119	
MAX.	370	835	1320	1850	2315	2625	
MIN.	180	420	675	975	1310	1560	
1N	290	725	1125	1580	2085	2510	
2N	575	1310	1935	2395	2740	3010	
3N	560	1185	1725	2150	2535	2830	
4N	450	1000	1530	1905	2340	2190	
5N	420	1060	1560	2050	2460	2750	
AVE.	459	1056	1575	2016	1432	2658	
MAX.	575	1310	1935	2395	2740	3010	
MIN.	290	725	1125	1580	2085	2190	
1N	410	1135	1720	2125	2500	2815	
2N	610	1390	1990	2500	2885	3110	
3N	595	1260	1835	2250	2670	2920	
4N	500	1250	1750	2250	2750	3100	
5N	550	1235	1810	2290	2670	2930	
AVE.	533	1264	1821	2283	2695	2975	
MAX.	610	1390	1990	2500	2885	3110	
MIN.	410	1135	1720	2125	2500	2815	
1N	420	1240	1840	2235	2585	2815	
2N	625	1270	1850	2375	2700	2980	
3N	600	1265	1850	2255	2615	2850	
4N	570	1280	1900	2475	2965	3210	
5N	520	1215	1800	2275	2670	2925	
AVE.	547	1254	1848	2323	2707	2956	
MAX.	625	1280	1900	2475	2965	3210	(122,500 PSI) 3200
MIN.	420	1215	1800	2235	2585	2815	(118,700 PSI) 2950
1N	505	1250	1780	2210	2550	2805	(119,100 PSI) 3015
2N	550	1255	1825	2325	2720	2990	(124,000 PSI) 2955
3N	625	1265	1765	2200	2525	2750	(117,300 PSI) 3200
4N	600	1325	1965	2540	2950	3170	(122,800 PSI) 2940
5N	535	1250	1800	2250	2625	2850	
AVE.	563	1269	1827	2305	2674	2912	
MAX.	625	1325	1965	2540	2950	3170	
MIN.	505	1250	1765	2200	2950	2750	

LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	105,000 TORQUE (in-#)	THEORETICAL YIELD PT. 130,000 TORQUE (in-#)
1H-L	(5) 100	225	365	520	695	825	
2H-L	L 100	205	310	415	535	625	
3H-L	L 105	225	360	535	685	765	
4H-L	L 100	210	300	400	505	625	
5H-L	L 95	235	300	405	520	650	
AVE.	100	220	337	455	588	698	
MAX.	105	235	365	535	695	825	
MIN.	95	205	300	400	505	625	
1H-L	125	300	475	645	795	920	
2H-L	110	245	375	485	610	710	
3H-L	90	310	345	475	600	700	
4H-L	115	260	375	490	605	700	
5H-L	105	260	395	515	645	760	
AVE.	109	275	393	522	651	758	
MAX.	125	310	475	645	795	920	
MIN.	90	245	345	475	600	700	
1H-L	L 100	250	375	530	725	850	
2H-L	130	290	440	565	690	790	
3H-L	L 75	175	280	390	520	625	
4H-L	L 70	165	280	390	515	600	
5H-L	L 100	215	325	462	590	700	
AVE.	95	219	340	467	608	713	
MAX.	130	290	440	565	725	850	
MIN.	70	165	280	390	515	600	
1H-L	115	290	450	615	800	920	
2H-L	L 85	210	320	470	625	745	
3H-L	80	200	315	415	540	645	
4H-L	85	185	300	415	535	625	
5H-L	115	255	385	525	665	775	
AVE.	96	228	354	488	633	742	
MAX.	115	290	450	615	800	920	
MIN.	80	185	300	415	535	625	
1H-L	L 75	200	310	455	625	750	1055
2H-L	120	275	415	550	705	815	1200
3H-L	95	220	340	455	575	680	1035
4H-L	95	215	325	455	570	670	915
5H-L	L 85	190	300	415	550	655	1000
AVE.	94	220	338	466	605	714	1041
MAX.	120	275	415	550	705	815	1200
MIN.	75	190	300	415	550	655	915

TORQUED FROM NUT

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	105,000 TORQUE (in-#)	THEORETICAL YIELD PT. 130,000 TORQUE (in-#)
1N-L	(5) 75	175	270	375	490	605	
2N-L	L 90	240	365	490	625	715	
3N-L	L 85	205	325	455	615	715	
4N-L	L 65	180	295	415	550	640	
5N-L	L 100	175	255	370	505	625	
AVE.	83	195	302	421	557	660	
MAX.	100	240	365	490	625	715	
MIN.	65	175	255	370	490	605	
1N-L	95	215	320	445	560	665	
2N-L	100	245	370	500	625	715	
3N-L	110	275	430	560	680	760	
4N-L	115	240	370	490	600	675	
5N-L	95	215	335	460	595	700	
AVE.	103	238	365	491	612	703	
MAX.	115	275	430	560	680	760	
MIN.	95	215	320	445	560	665	
1N-L	L 75	155	290	425	530	640	
2N-L	L 70	175	320	485	635	735	
3N-L	L 60	150	275	425	565	670	
4N-L	L 65	140	315	465	605	695	
5N-L	L 50	135	250	375	500	625	
AVE.	64	151	290	435	567	673	
MAX.	75	175	320	485	635	735	
MIN.	50	135	250	375	500	625	
1N-L	85	195	315	435	555	650	
2N-L	115	275	410	540	680	780	
3N-L	125	255	385	510	630	710	
4N-L	125	275	420	550	675	750	
5N-L	100	235	350	455	575	690	
AVE.	110	247	376	498	623	716	
MAX.	125	275	420	550	680	780	
MIN.	85	195	315	435	555	650	
1N-L	100	240	350	470	590	765	915
2N-L	60	180	325	480	620	700	860
3N-L	150	300	455	555	680	750	1000
4N-L	50	140	275	405	565	690	1015
5N-L	50	150	280	440	620	715	1020
AVE.	82	202	337	470	615	724	982
MAX.	150	300	455	555	680	765	1020
MIN.	50	140	275	405	565	690	915

COMMENTS:
(1) DUE TO SLOT DRIVER TOOL (HARDNESS: ROCKWELL C-48) BREAKING WHILE TORQUING FROM THE HEAD IN THE DRY CONDITIONS, HIGHER TENSION VALUES THAN THOSE SHOWN WERE NOT ATTEMPTED
(2) SPECIMEN 5H WAS NOT TESTED DUE TO LOSS OF ALL SLOT DRIVER TOOLS THROUGH BREAKAGE ON SPECIMENS 1H THRU 4H.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING OF EACH SPECIMEN FOR DRY CONDITIONS ONLY DUE TO SEATING. COUNTERSINK IN HEAD SPACER BLOCK SANDED WITH EMERY CLOTH BY HAND.

PAGE 6A

SHEET #1 OF 2 SHEETS

DATE — JAN. 24, 1957
SIZE — "V", 9/16-18 UNF-3A
SCREW OR BOLT — AN 509-916R52 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (SLOT HEAD)
NUT — AN 365-918 MFD. BY ELASTIC STOP NUT CORP., UNION, NEW JERSEY

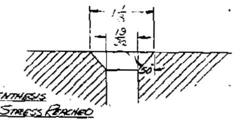
TEST CELL — NO.
TORSION — 7A
COMPRESSION — 5C

TEST DATA

CONTRACT NO AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESES DENOTE TENSILE STRESS REACHED

SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)



V

NON LUBRICATED

TORQUED FROM HEAD

Torquing No.	Specimen No.	Torque (in.-#)	Torque (in.-#)	Torque (in.-#)	Torque (in.-#)	Torque (in.-#)	Torque (in.-#)	Torque (in.-#)
Initial Torquing	1H							
	2H							
	3H							
	4H							
	5H							
	Ave.							
	Max.							
	Min.							
2nd Torquing	1H							
	2H							
	3H							
	4H							
	5H							
	Ave.							
	Max.							
	Min.							
3rd Torquing	1H							
	2H							
	3H							
	4H							
	5H							
	Ave.							
	Max.							
	Min.							
4th Torquing	1H							
	2H							
	3H							
	4H							
	5H							
	Ave.							
	Max.							
	Min.							
5th Torquing	1H							
	2H							
	3H							
	4H							
	5H							
	Ave.							
	Max.							
	Min.							

TORQUED FROM NUT

Tensile Stress (#/in²)

Torquing No.	Specimen No.	20,000 Torque (in.-#)	60,000 Torque (in.-#)	100,000 Torque (in.-#)	Theoretical Yield Pt. 150x10³ 140,000 Torque (in.-#)	Torque (in.-#)	Torque (in.-#)	Torque (in.-#)
Initial Torquing	1N	355	1375	2260				
	2N	425	1345	2175				
	3N							
	4N							
	5N							
	Ave.	440	1360	2218				
	Max.	425	1375	2260				
	Min.	355	1345	2175				
2nd Torquing	1N	935	2100	2985				
	2N	705	1800	2725				
	3N							
	4N							
	5N							
	Ave.	818	1950	2855				
	Max.	935	2100	2985				
	Min.	705	1800	2725				
3rd Torquing	1N	1000	2275	3135				
	2N	775	2125	3215				
	3N							
	4N							
	5N							
	Ave.	888	2200	3175				
	Max.	1000	2275	3215				
	Min.	775	2125	3135				
4th Torquing	1N	1100	2580	3445				
	2N	815	2230	3365				
	3N							
	4N							
	5N							
	Ave.	958	2405	3405				
	Max.	1100	2580	3445				
	Min.	815	2230	3365				
5th Torquing	1N	1090	2365	3300	4025	(151,500 psi) 4360 ← Bolt Yielded		
	2N	790	2205	3300	4075	(159,000 psi) 4530 ← Bolt Yielded		
	3N							
	4N							
	5N							
	Ave.	940	2285	3300	4050			
	Max.	1090	2365	3300	4075			
	Min.	790	2205	3300	4025			

LUBRICATED

TORQUED FROM HEAD

Tensile Stress (#/in²)

Torquing No.	Specimen No.	20,000 Torque (in.-#)	60,000 Torque (in.-#)	100,000 Torque (in.-#)	Theoretical Yield Pt. 150x10³ 140,000 Torque (in.-#)	Torque (in.-#)	Torque (in.-#)	Torque (in.-#)
Initial Torquing	1H-L	L 195	600	900				
	2H-L	L 250	625	1290				
	3H-L	L 285	640	1140				
	4H-L	L 220	650	1265				
	5H-L	L 210	575	1145				
	Ave.	232	618	1148				
	Max.	285	650	1290				
	Min.	195	575	900				
2nd Torquing	1H-L	L 190	475	885				
	2H-L	L 175	615	1175				
	3H-L	L 220	635	1195				
	4H-L	L 175	675	1275				
	5H-L	L 145	540	1050				
	Ave.	181	588	1116				
	Max.	220	675	1275				
	Min.	195	475	885				
3rd Torquing	1H-L	L 205	525	1000				
	2H-L	L 170	720	1225				
	3H-L	300	815	1400				
	4H-L	L 175	675	1325				
	5H-L	L 110	525	1105				
	Ave.	192	652	1211				
	Max.	300	815	1400				
	Min.	110	525	1000				
4th Torquing	1H-L	L 205	550	1045				
	2H-L	L 215	730	1250				
	3H-L	L 240	760	1490				
	4H-L	L 165	715	1330				
	5H-L	L 125	590	1125				
	Ave.	190	669	1248				
	Max.	240	760	1490				
	Min.	125	550	1045				
5th Torquing	1H-L	L 165	525	995	(122,000 psi) 1745	← Bolt Yielded		
	2H-L	L 205	665	1220	(108,000 psi) 1550	← Bolt Yielded		
	3H-L	L 225	700	1400 ← Bolt Yielded				
	4H-L	L 190	695	1260	(106,000 psi) 1625 ← Bolt Yielded			
	5H-L	L 110	525	1035	(110,000 psi) 1400 ← Bolt Yielded			
	Ave.	179	622	1182				
	Max.	225	700	1400				
	Min.	110	525	995				

TORQUED FROM NUT

Tensile Stress (#/in²)

Torquing No.	Specimen No.	20,000 Torque (in.-#)	60,000 Torque (in.-#)	100,000 Torque (in.-#)	Theoretical Yield Pt. 150x10³ 140,000 Torque (in.-#)	180,000 Torque (in.-#)	Torque (in.-#)	Torque (in.-#)
Initial Torquing	1N-L	L 180	390	700	1130	(155,000 psi) 1810	Bolt Yielded	
	2N-L	L 140	415	770	1140			
	3N-L	L 170	470	800	1170			
	4N-L	L 250	790	(95,000 psi) 1335 ← Bolt Yielded				
	5N-L	L 255	765	1340				
	Ave.	155	442	785	1155 ← Bolts 2NL & 3NL only			
	Max.					(Other bolts rerun on separate data sheet)		
	Min.							
2nd Torquing	1N-L	Test	Discontinued					
	2N-L	225	595	960	1435			
	3N-L	L 150	470	835	1300			
	4N-L	L 200	760	1270 ← Bolt Yielded				
	5N-L	L 185	670	1190				
	Ave.	188	532	898	1368 ← See above note			
	Max.							
	Min.							
3rd Torquing	1N-L	Test	Discontinued					
	2N-L	L 106	415	805	1260			
	3N-L	L 125	450	870	1480			
	4N-L	Test	Discontinued					
	5N-L	L 175	750	(93,000 psi) 1415 ← Bolt Yielded				
	Ave.	112	438	838	1370 ← See above note			
	Max.							
	Min.							
4th Torquing	1N-L							
	2N-L	200	600	1000	1500			
	3N-L	L 275	455	845	1280			
	4N-L							
	5N-L							
	Ave.	238	528	923	1390			
	Max.							
	Min.							
5th Torquing	1N-L							
	2N-L	L 135	420	800	1375	(143,000 psi) 1550	← Bolt Yielded	
	3N-L	L 135	475	890	1350 ← Bolt Yielded			
	4N-L							
	5N-L							
	Ave.	135	448	845	1313			
	Max.							
	Min.							

COMMENTS: (1) After yielding the above bolts, it was found that the calibration of the tension cell 5C was different for the AN-509 flat head screws. It was necessary to recalibrate the strain gage cell before continuing with the tests. The values of tensile stress originally recorded on this data sheet were corrected to the new calibrated values for the AN509-916 R52 bolts and plotted on the graph dated 25 Jan. '57. The balance of the AN 509-916 R52 bolts were subsequently tested using the regular step-values of tensile stress and the results are shown on data sheet of 19 April '57.

PAGE NO

SHEET #2 OF 2 SHEETS

DATE — 19 APRIL 1957 (SEE ALSO TEST DATA 24 JAN, 1957)
SIZE — "V" 9/16 -18 UNF-3A
SCREW OR BOLT — AN509-916R52 MFTD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (SLOT HEAD)
NUT — AN 365-918 MFTD. BY ELASTIC STOP NUT CORP., UNION, N. J.

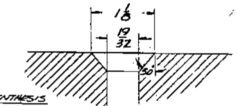
TEST CELL — Nº
TORSION — 7A
COMPRESSION — 5C

TEST DATA

CONTRACT Nº AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED

SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)



V

NON LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Pt. 130,000
Initial Torquing	1H	450	650	1000	(2)			
	2H	565	890	(2)				
	3H	400	1005	(2)				
	4H	350	975	(2)				
	5H	385	950	(2)				
	Ave.	430	894	1000				
	Max.	565	1005					
	Min.	350	650					
2nd Torquing	1H	500	1125	1600	(2)			
	2H	555	1150	(2)				
	3H	400	1225	(2)				
	4H	445	1240	(2)				
	5H	500	1335	(2)				
	Ave.	480	1215	1600				
	Max.	555	1335					
	Min.	400	1125					
3rd Torquing	1H	540	1375	1725	(2)			
	2H	460	1375	(2)				
	3H	500	1350	(2)				
	4H	500	1340					
	5H	530	1425					
	Ave.	506	1373	1725				
	Max.	540	1425					
	Min.	460	1340					
4th Torquing	1H	575	1575	2000	← TOOL RUPT'D	BROKE AND SLOTTED HEAD		
	2H	550	1495	(2)				
	3H	600	1400	(2)				
	4H	500	1510	(2)				
	5H	575	1545	(2)				
	Ave.	560	1505	2000				
	Max.	600	1575					
	Min.	500	1400					
5th Torquing	1H	TEST	DISCONTINUED					
	2H	575	1665	2360	(2)			
	3H	560	1510	2200	(2)			
	4H	610	1635	2215	(2)			
	5H	485	1575	2225	(2)			
	Ave.	558	1596	2250				
	Max.	610	1665	2360				
	Min.	485	1510	2200				

NON LUBRICATED — TORQUED FROM NUT

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Pt. 130,000
Initial Torquing	(1) 1N	215	680	1145	1590	2015	2320	
	(1) 2N	215	680	1145	1590	2015	2320	
	3N	240	660	1000	1420	1940	2260	
	4N	260	620	1040	1500	2000	2300	
	5N	240	680	1180	1620	2120	2500	
	Ave.	234	664	1102	1544	2018	2340	
	Max.	260	680	1180	1620	2120	2500	
	Min.	215	620	1000	1420	1940	2260	
2nd Torquing	(1) 1N	470	1130	1695	2210	2660	2850	
	(1) 2N	470	1130	1695	2210	2660	2850	
	3N	360	740	1200	1560	2040	2320	
	4N	360	900	1500	2000	2400	2800	
	5N	320	1080	1620	2200	2600	2840	
	Ave.	396	996	1542	2036	2472	2732	
	Max.	470	1130	1695	2210	2660	2850	
	Min.	320	740	1200	1560	2040	2320	
3rd Torquing	(1) 1N	485	1240	1900	2480	2955	3275	
	(1) 2N	485	1240	1900	2480	2955	3275	
	3N	380	800	1320	1680	2180	2420	
	4N	400	1180	1660	1700	1960	2140	
	5N	400	1020	1660	2260	2740	3020	
	Ave.	430	1096	1688	2120	2558	2826	
	Max.	485	1240	1900	2480	2955	3275	
	Min.	380	800	1320	1680	1960	2140	
4th Torquing	(1) 1N	525	1360	2080	2685	3175	3455	
	(1) 2N	525	1360	2080	2685	3175	3455	
	3N	380	820	1360	1880	2380	2580	
	4N	500	900	1380	2120	2800	3140	
	5N	380	1340	2000	2600	3040	3340	
	Ave.	462	1156	1780	2394	2914	3194	
	Max.	525	1360	2080	2685	3175	3455	
	Min.	380	820	1360	1880	2380	2580	
5th Torquing	(1) 1N	520	1300	1980	2580	3080	3405	3870
	(1) 2N	520	1300	1980	2580	3080	3405	3870
	3N	440	1140	1660	2160	2500	2720	2900
	4N	520	1300	1920	2500	3040	3380	(116,500 PSI) 3600
	5N	380	1560	2280	2900	3300	3500	(111,100 PSI) 3780
	Ave.	476	1320	1964	2544	3000	3282	3535
	Max.	520	1560	2280	2900	3300	3500	3870
	Min.	380	1140	1660	2160	2500	2720	2900

BOLT YIELDED

LUBRICATED — TORQUED FROM HEAD

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	106,000	Theoretical Yield Pt. 130,000
Initial Torquing	(1) 1H-L	L (3) 130	310	500	725	990	1210	
	(1) 2H-L	L ″	″	″	″	″	″	
	(1) 3H-L	L ″	″	″	″	″	″	
	(1) 4H-L	L ″	″	″	″	″	″	
	(1) 5H-L	L ″	″	″	″	″	″	
	Ave.	130	310	500	725	990	1210	
	Max.							
	Min.							
2nd Torquing	(1) 1H-L	L 85	270	470	700	960	1180	
	(1) 2H-L	L ″	″	″	″	″	″	
	(1) 3H-L	L ″	″	″	″	″	″	
	(1) 4H-L	L ″	″	″	″	″	″	
	(1) 5H-L	L ″	″	″	″	″	″	
	Ave.	85	270	470	700	960	1180	
	Max.							
	Min.							
3rd Torquing	(1) 1H-L	L 90	310	520	770	1055	1300	
	(1) 2H-L	L ″	″	″	″	″	″	
	(1) 3H-L	L ″	″	″	″	″	″	
	(1) 4H-L	L ″	″	″	″	″	″	
	(1) 5H-L	L ″	″	″	″	″	″	
	Ave.	90	310	520	770	1055	1300	
	Max.							
	Min.							
4th Torquing	(1) 1H-L	L 85	305	555	805	1090	1340	
	(1) 2H-L	L ″	″	″	″	″	″	
	(1) 3H-L	L ″	″	″	″	″	″	
	(1) 4H-L	L ″	″	″	″	″	″	
	(1) 5H-L	L ″	″	″	″	″	″	
	Ave.	85	305	555	805	1090	1340	
	Max.							
	Min.							
5th Torquing	(1) 1H-L	L 80	295	505	745	1020	1210	(110,000 PSI) 1500
	(1) 2H-L	L ″	″	″	″	″	″	″
	(1) 3H-L	L ″	″	″	″	″	″	″
	(1) 4H-L	L ″	″	″	″	″	″	″
	(1) 5H-L	L ″	″	″	″	″	″	″
	Ave.	80	295	505	745	1020	1210	(110,000 PSI) 1500
	Max.							
	Min.							

BOLT YIELDED

LUBRICATED — TORQUED FROM NUT

Torquing Nº	Specimen Nº	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Pt. 130,000
Initial Torquing	1N-L	L (3) 90	260	420	600	800	960	
	(1) 2N-L	L 80	210	360	520	685	820	
	(1) 3N-L	L 80	210	360	520	685	820	
	4N-L	L 100	240	440	700	940	1100	
	5N-L	L 100	260	480	700	960	1100	
	Ave.	90	236	412	608	814	960	
	Max.	100	260	480	700	960	1100	
	Min.	80	210	360	520	685	820	
2nd Torquing	1N-L	L 80	200	360	560	760	940	
	(1) 2N-L	90	265	445	620	795	940	
	(1) 3N-L	L 90	265	445	620	795	940	
	4N-L	L 80	220	380	600	860	1100	
	5N-L	L 100	240	440	700	940	1100	
	Ave.	88	238	414	620	830	1004	
	Max.	100	265	445	700	940	1100	
	Min.	80	200	360	560	760	940	
3rd Torquing	1N-L	L 100	200	380	560	760	940	
	(1) 2N-L	L 45	180	340	520	720	885	
	(1) 3N-L	L 45	180	340	520	720	885	
	4N-L	L 80	220	400	640	900	1060	
	5N-L	L 100	240	460	680	940	1260	
	Ave.	74	204	384	584	808	1006	
	Max.	100	240	460	680	940	1260	
	Min.	45	180	340	520	720	885	
4th Torquing	1N-L	L 100	200	360	580	820	1000	
	(1) 2N-L	130	310	450	630	820	975	
	(1) 3N-L	L 130	310	450	630	820	975	
	4N-L	L 80	280	540	700	940	1100	
	5N-L	L 100	260	480	700	960	1140	
	Ave.	108	272	456	648	872	1038	
	Max.	130	310	540	700	960	1140	
	Min.	80	200	360	580	820	975	
5th Torquing	1N-L	L 90	180	360	560	800	1020	(119,200 PSI) 1500
	(1) 2N-L	L 60	205	360	550	745	900	1190
	(1) 3N-L	L 60	205	360	550	745	900	1190
	4N-L	L 100	260	460	700	900	1060	(108,500 PSI) 1240
	5N-L	L 100	280	500	760	1040	(100,700 PSI) 1500	←
	Ave.	82	226	408	624	846	970	1190
	Max.	100	280	500	760	1040	1060	
	Min.	60	180	360	550	745	900	

BOLT YIELDED

COMMENTS:
(1) VALUES SHOWN DERIVED FROM GRAPH OF TEST DATA TAKEN 24 JAN. '57, USING CORRECTED CALIBRATION. (SEE GRAPH DATED 25 JAN. '57)
(2) DUE TO SLOT DRIVER TOOL (HARDNESS: ROCKWELL C-48) BREAKING WHILE TORQUING FROM THE HEAD IN THE DRY CONDITION HIGHER TENSILE STRESS VALUES THAN THOSE SHOWN WERE NOT ATTEMPTED.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING FOR ALL FOUR CONDITIONS DUE TO SCARRING. COUNTERSINK OF HEAD SPACER BLOCK WAS SANDED WITH EMERY CLOTH BY HAND.

PAGE 4A

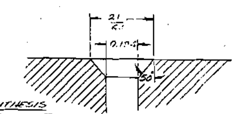
Date: 10 January 1957
Size: "W" 8-32NF-3A
Screw or Bolt: AN509-8R37 Mfd. by Aero Bolt & Screw Co. Stamford, Conn. (slot head)
Nut: NMJ-82 Alum. Mfd. by Elastic Stop Nut Corp. Union, New Jersey

Test Seq. No.: Torsion -7B, Compression -5A

Test Data

Contract No. AF 33(616)2808
P-1227

Note: Figures in parenthesis denote tensile stress reached



Sketch showing head countersink in hardened steel spacing block (Rockwell "C" scale 60)

W — Non Lubricated — Torqued From Head

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Point 130,000
Initial Torquing	1H	5	9	15	21	28	(2)	X
	2H	6	11	15	21	25	(2)	X
	3H	5	11	18	24	32	(2)	X
	4H	5	11	16	24	30	(2)	X
	5H	6	12	17	25	32	(2)	X
	Ave.	5	11	16	23	29		
	Max.	6	12	18	25	32		
	Min.	5	9	15	21	25		
2nd Torquing	1H	6	13	20	28	35	(2)	X
	2H	7	14	19	26	35	(2)	X
	3H	7	16	23	32	40	(2)	X
	4H	6	15	22	29	37	(2)	X
	5H	8	16	25	30	35	(2)	X
	Ave.	7	15	22	29	36		
	Max.	8	16	25	32	40		
	Min.	6	13	19	26	35		
3rd Torquing	1H	8	15	24	31	38	(2)	X
	2H	9	16	24	30	40	(2)	X
	3H	9	18	26	35	39	(2)	X
	4H	6	16	25	30	39	(2)	X
	5H	8	18	27	35	41	(2)	X
	Ave.	8	17	25	32	39		
	Max.	9	18	27	35	41		
	Min.	6	15	24	30	38		
4th Torquing	1H	8	15	25	33	40	(2)	X
	2H	8	16	25	31	40	(2)	X
	3H	10	20	29	39	47	(2)	X
	4H	6	16	25	35	41	(2)	X
	5H	8	18	27	36	40	(2)	X
	Ave.	8	17	26	35	42		
	Max.	10	20	29	39	47		
	Min.	6	15	25	31	40		
5th Torquing	1H	8	18	26	36	45	50	(114,500 PSI) 52 Bolt Yielded
	2H	9	19	26	35	43	50	60
	3H	10	20	31	41	48	54	65
	4H	7	16	27	35	43	45 ← Slot Ruptured	
	5H	9	23(1)	35	44(1)	54	58	(119,700 PSI) 60 Bolt Yielded
	Ave.	9	19	29	38	47	51	62
	Max.	10	23	35	44	54	58	65
	Min.	7	16	26	35	43	45	60

W — Non Lubricated — Torqued From Nut

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Point 130,000
Initial Torquing	1N	6	15	22	31	42	(2)	X
	2N	6	15	22	29	35	(2)	X
	3N	7	15	25	37	42	(2)	X
	4N	8	16	25	33	43	(2)	X
	5N	6	15	23	32	43	(2)	X
	Ave.	7	15	23	32	41		
	Max.	8	16	25	37	43		
	Min.	6	15	22	29	35		
2nd Torquing	1N	7	15	24	32	43	(2)	X
	2N	6	14	20	27	34	(2)	X
	3N	6	14	25	35	45	(2)	X
	4N	8	16	25	33	41	(2)	X
	5N	7	15	23	32	43	(2)	X
	Ave.	7	15	23	32	41		
	Max.	8	16	25	35	45		
	Min.	6	14	20	27	34		
3rd Torquing	1N	6	15	24	33	40	(2)	X
	2N	7	15	21	28	35	(2)	X
	3N	6	15	25	34	43	(2)	X
	4N	8	16	25	33	44	(2)	X
	5N	7	15	24	31	42	(2)	X
	Ave.	7	15	24	32	41		
	Max.	8	16	25	34	44		
	Min.	6	15	21	28	35		
4th Torquing	1N	6	15	23	31	41	(2)	X
	2N	8	16	23	30	35	(2)	X
	3N	6	15	25	33	42	(2)	X
	4N	8	18	25	35	43	(2)	X
	5N	8	15	25	31	40	(2)	X
	Ave.	7	16	24	32	40		
	Max.	8	18	25	35	43		
	Min.	6	15	23	30	35		
5th Torquing	1N	6	15	22	30	40	49	62
	2N	8	17	25	33	40	44	50
	3N	6	15	24	33	43	50	68
	4N	8	19	28	35	45	51	67
	5N	6	15	24	30	40	49	63
	Ave.	7	16	25	32	42	49	62
	Max.	7	19	27	35	45	51	68
	Min.	6	15	22	30	40	44	50

W — Lubricated — Torqued From Head

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Point 130,000
Initial Torquing	1H-L	L(3) 4	8	13	16	20	23	X
	2H-L	L 4	8	13	19	23	30	X
	3H-L	L 4	10	14	16	20	25	X
	4H-L	L 4	8	12	15	20	21	X
	5H-L	L 4	9	14	16	21	24	X
	Ave.	4	9	13	16	21	25	
	Max.	4	10	14	19	23	30	
	Min.	4	8	12	15	20	21	
2nd Torquing	1H-L	4	8	12	15	19	22	X
	2H-L	4	7	11	14	18	21	X
	3H-L	4	7	11	13	19	20	X
	4H-L	4	9	11	15	19	21	X
	5H-L	4	8	12	15	20	23	X
	Ave.	4	8	11	14	19	21	
	Max.	4	9	12	15	20	23	
	Min.	4	7	11	13	18	20	
3rd Torquing	1H-L	4	8	12	15	19	22	X
	2H-L	3	6	10	15	19	20	X
	3H-L	4	7	10	14	19	22	X
	4H-L	5	9	14	15	20	23	X
	5H-L	4	8	12	14	20	23	X
	Ave.	4	8	12	15	19	22	
	Max.	5	9	14	15	20	23	
	Min.	3	6	10	14	19	20	
4th Torquing	1H-L	4	7	11	15	19	20	X
	2H-L	3	8	12	16	19	23	X
	3H-L	4	8	12	15	19	22	X
	4H-L	5	9	13	15	20	22	X
	5H-L	4	8	14	16	20	23	X
	Ave.	4	8	12	15	19	22	
	Max.	5	9	14	16	20	23	
	Min.	3	7	11	15	19	20	
5th Torquing	1H-L	4	8	11	15	19	23	31
	2H-L	4	9	13	17	20	25	30
	3H-L	4	8	12	15	20	23	30
	4H-L	4	8	14	16	18	22	25
	5H-L	4	9	13	16	20	25	27
	Ave.	4	7	13	16	19	24	29
	Max.	4	9	14	17	20	25	31
	Min.	4	7	11	15	18	22	25

W — Lubricated — Torqued From Nut

Tensile Stress (#/in²); all values Torque (in.-#)

Torquing No.	Specimen No.	10,000	30,000	50,000	70,000	90,000	105,000	Theoretical Yield Point 130,000
Initial Torquing	1N-L	L(3) 5	8	12	15	20	23	X
	2N-L	L 3	7	10	14	16	21	X
	3N-L	L 3	7	12	15	20	25	X
	4N-L	L 3	7	11	15	20	25	X
	5N-L	L 4	8	12	15	18	20	X
	Ave.	4	7	11	15	19	23	
	Max.	5	8	12	15	20	25	
	Min.	3	7	10	14	16	20	
2nd Torquing	1N-L	4	8	12	15	19	22	X
	2N-L	4	8	11	14	19	21	X
	3N-L	4	7	10	15	20	25	X
	4N-L	3	8	12	15	20	24	X
	5N-L	3	8	10	15	17	20	X
	Ave.	4	8	11	15	19	22	
	Max.	4	8	12	15	20	25	
	Min.	3	7	10	14	17	20	
3rd Torquing	1N-L	3	8	13	15	20	23	X
	2N-L	4	8	11	15	19	24	X
	3N-L	3	8	11	16	22	26	X
	4N-L	3	9	12	16	23	26	X
	5N-L	3	9	12	15	19	21	X
	Ave.	3	8	12	15	20	24	
	Max.	4	9	13	16	23	26	
	Min.	3	8	11	15	18	21	
4th Torquing	1N-L	3	9	13	17	20	23	X
	2N-L	3	8	11	15	20	24	X
	3N-L	3	8	13	18	23	28	X
	4N-L	5	9	13	16	21	26	X
	5N-L	4	9	12	15	19	21	X
	Ave.	4	9	12	16	21	24	
	Max.	5	9	13	18	23	28	
	Min.	3	8	11	15	19	21	
5th Torquing	1N-L	3	8	12	15	20	23	28
	2N-L	3	8	13	15	20	25	31
	3N-L	3	8	14	19	25	29	35
	4N-L	4	10	13	17	23	27	38
	5N-L	4	9	12	15	19	23	32
	Ave.	3	9	13	16	21	25	33
	Max.	4	10	14	19	25	29	38
	Min.	3	8	12	15	19	23	28

Comments:
(1) Ruptured slot caused overshoot of readings requiring interpolation.
(2) Due to rupturing of the slot head and yielding of the screw at points above 90,000 psi in dry torquing condition (see data sheet on "D" screw) screws were not torqued above 90,000 psi until 5th torquing.
(3) Runs of lubricated torquings are marked with an "L" at the beginning of the run to indicate initial lubrication and subsequent lubrications of nut or head bearing surfaces.
(4) Spacer blocks were sanded after 5th torquing of each specimen for the dry conditions only due to scarring. Countersink of head spacer block was sanded with emery cloth by hand.

WADC TR 57-330

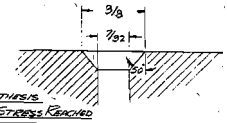
111

DATE — 25 APRIL 1956
SIZE — X" 10-32NF-3A
SCREW OR BOLT — AN509-10R37 MFTD. BY AERO BOLT & SCREW CO., STAMFORD, CONN. (PHILLIPS HEAD)
NUT — NMJ-02 ALUMINUM " " ELASTIC STOP NUT CORP, UNION, N.J.

TEST CELL — N°
TORSION — 78
COMPRESSION - 5A

TEST DATA
CONTRACT N° AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACER BLOCK (ROCKWELL 'C' - SCALE 60)

X

NON LUBRICATED

TORQUED FROM HEAD

INITIAL TORQUING N°	SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
	1H	10	20	34	50	69	83	
	2H	7	19	32	45	69	89	
	3H	6	21	36	59	93	111	
	4H	9	16	32	49	69	71	
	5H	6	18	36	51	71	88	
	AVE.	7	19	34	51	74	88	
	MAX.	10	21	36	59	93	111	
	MIN.	4	16	32	45	69	71	
2ND TORQUING	1H	10	23	37	51	67	83	
	2H	9	29	38	47	68	90	
	3H	15	36	57	88	124	145	
	4H	10	26	40	54	72	86	
	5H	8	20	35	53	73	89	
	AVE.	10	27	41	59	81	99	
	MAX.	15	36	57	88	124	145	
	MIN.	8	20	35	47	67	88	
3RD TORQUING	1H	11	26	39	55	75	90	
	2H	10	30	40	52	73	93	
	3H	14	39	60	91	128	146	
	4H	11	28	43	56	78	92	
	5H	10	30	41	58	77	91	
	AVE.	11	31	45	62	86	102	
	MAX.	14	39	60	91	128	146	
	MIN.	10	26	39	52	73	90	
4TH TORQUING	1H	12	29	46	64	83	103	
	2H	11	31	45	68	90	118	
	3H	15	43	65	99	132	148	
	4H	13	31	46	60	80	105	
	5H	12	32	47	62	79	100	
	AVE.	13	33	50	70	93	115	
	MAX.	15	43	65	94	132	148	
	MIN.	11	29	45	60	79	100	
5TH TORQUING	1H	19	31	50	69	95	117	152
	2H	13	33	51	70	96	120	153
	3H	13	46	69	97	135	150	155
	4H	13	32	50	68	83	97	162 (115,800 PSI)
	5H	14	35	51	69	85	111	116 ①
	AVE.	13	35	54	75	99	119	156
	MAX.	14	46	69	97	135	150	162
	MIN.	13	31	50	68	83	97	152

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1N	5	15	26	36	50	65	
2N	8	20	32	40	46	50	
3N	9	16	31	45	63	80	
4N	9	16	29	41	56	71	
5N	7	21	33	40	47	55	
AVE.	7	18	30	40	52	64	
MAX.	9	21	33	45	63	80	
MIN.	4	15	26	36	46	55	
1N	5	15	26	40	53	70	
2N	8	21	31	39	47	53	
3N	8	17	30	44	62	72	
4N	6	19	31	44	58	75	
5N	8	20	32	41	49	61	
AVE.	7	18	30	42	54	66	
MAX.	8	21	32	44	62	75	
MIN.	5	15	26	39	47	59	
1N	6	16	28	42	61	84	
2N	9	22	33	41	49	60	
3N	9	21	32	46	67	86	
4N	8	19	34	49	65	84	
5N	9	23	35	48	59	82	
AVE.	8	20	32	45	60	79	
MAX.	9	23	35	49	67	86	
MIN.	6	16	28	41	49	60	
1N	6	18	30	45	68	90	
2N	11	28	39	46	57	72	
3N	9	21	39	48	61	85	
4N	9	21	34	48	69	90	
5N	13	25	31	45	56	67	
AVE.	10	23	33	46	62	81	
MAX.	13	28	34	48	69	90	
MIN.	6	18	30	45	56	67	
1N	7	20	32	48	70	94	132
2N	16	27	36	41	46	53	61
3N	10	22	36	52	71	90	110
4N	10	23	35	50	70	89	112
5N	14	25	39	50	60	67	78
AVE.	11	23	36	48	63	79	99
MAX.	16	27	39	52	71	94	132
MIN.	7	20	32	41	46	53	61

LUBRICATED

TORQUED FROM HEAD

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1H-L (1)	6	17	25	34	40		
2H-L 1	9	19	26	32	38		
3H-L 4	11	16	20	24	26		
4H-L 6	19	24	33	45	50		
5H-L 3	7	15	21	29	36		
AVE.	9	18	25	33	38		
MAX.	14	24	33	45	50		
MIN.	6	15	20	24	26		
1H-L	3	9	16	23	33	39	
2H-L	4	13	19	26	30	33	
3H-L	4	9	15	19	24	28	
4H-L	6	11	20	27	36	40	
5H-L	2	8	15	21	30	36	
AVE.	4	10	17	23	31	35	
MAX.	6	13	20	27	36	40	
MIN.	2	8	16	19	24	28	
1H-L	4	10	18	26	35	41	
2H-L	2	9	16	21	25	29	
3H-L	4	10	15	19	25	29	
4H-L	6	12	20	25	33	38	
5H-L	2	8	15	23	32	38	
AVE.	4	10	17	23	30	35	
MAX.	6	12	20	26	35	41	
MIN.	2	8	15	19	25	29	
1H-L 3	11	25	39	43	45		
2H-L 2	8	19	19	26	31		
3H-L 3'	10	17	21	24	26		
4H-L 1	9	14	21	28	38		
5H-L 7	7	14	20	30	35		
AVE.	9	17	24	30	35		
MAX.	11	25	39	43	45		
MIN.	7	14	19	24	26		
1H-L 5	11	19	27	34	38	41	
2H-L 1	10	16	21	29	31	39	
3H-L 3	10	15	21	25	27	31	
4H-L 2	7	15	22	31	38	50	
5H-L 2	8	15	24	31	42	50	
AVE.	9	16	23	29	35	42	
MAX.	11	19	27	34	42	50	
MIN.	7	15	21	24	27	31	

TORQUED FROM NUT

SPECIMEN N°	TENSILE STRESS (#/IN²) 10,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	50,000 TORQUE (IN.-#)	70,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	105,000 TORQUE (IN.-#)	THEORETICAL YIELD PT. 130,000 TORQUE (IN.-#)
1N-L (2) 5	9	15	23	33	44		
2N-L 4	12	19	26	34	45		
3N-L 3	8	16	25	40	59		
4N-L 4	9	14	21	29	43		
5N-L 4	9	19	20	28	32		
AVE.	9	16	23	33	45		
MAX.	12	19	26	40	59		
MIN.	8	14	20	28	32		
1N-L	8	16	25	35	49		
2N-L	15	25	40	50	59		
3N-L	9	15	22	31	47		
4N-L	9	15	22	30	42		
5N-L	10	15	21	29	35		
AVE.	10	17	26	35	45		
MAX.	15	25	40	50	54		
MIN.	8	15	21	29	35		
1N-L	10	16	28	36	48		
2N-L	15	25	41	48	52		
3N-L	10	17	25	35	48		
4N-L	10	17	26	32	47		
5N-L	12	18	25	35	40		
AVE.	11	19	29	37	47		
MAX.	15	25	41	48	52		
MIN.	10	16	25	32	40		
1N-L 5	10	16	25	35	45		
2N-L 4	9	19	32	29	35		
3N-L 3	8	19	31	30	40		
4N-L 4	9	15	22	29	35		
5N-L 3	8	19	22	31	42		
AVE. 4	9	16	22	31	39		
MAX. 5	10	19	25	35	45		
MIN. 3	8	14	21	29	35		
1N-L	9	15	26	37	45	75	
2N-L	10	20	23	30	41	61	
3N-L	10	19	28	42	57	86	
4N-L	10	14	24	32	45	72	
5N-L	18	17	23	27	31	40	
AVE.	10	17	25	34	44	65	
MAX.	12	20	28	42	57	86	
MIN.	9	15	23	27	31	40	

COMMENTS:
1. PHILLIPS HEAD DRIVER BROKE IN HEAD OF BOLT 5-H WHILE ATTEMPTING TO REACH THE THEORETICAL YIELD POINT AT END OF 5TH TORQUING.
2. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INIDAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
3. SPACER BLOCKS WERE SANDED AFTER THE 5TH TROQUING OF EACH SPECIMEN FOR THE DRY CONDITIONS ONLY. DUE TO SCARRING. COUNTERSINK OF HEAD SPACER BLOCK SANDED WITH EMERY CLOTH BY HAND.

DATE — 20 APRIL 1956

SIZE — Y 1/4-28UNF-3A

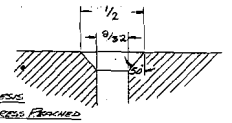
SCREW OR BOLT — AN 509-416R37 MFD BY AERO BOLT & SCREW CO., STAMFORD, CONN. (PHILLIPS HEAD)

NUT — NMJ-048, ALUM. " " ELASTIC STOP NUT CORP., UNION, N.J.

TEST CELL — No.
TORSION — 7B
COMPRESSION — 5A

TEST DATA
CONTRACT No. AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL C SCALE 60)

Y

1 NON LUBRICATED

TORQUED FROM HEAD

INITIAL TORQUING	SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	105,000 TORQUE (in-#)	THEORETICAL YIELD PT. 130,000 TORQUE (in-#)
	1H	15	42	71	107	165	210	
	2H	16	40	65	98	143	175	
	3H	16	40	67	95	135	156	
	4H	12	39	66	97	131	170	
	5H	15	41	65	95	137	172	
	AVE.	15	40	67	98	142	177	
	MAX.	16	42	71	107	165	210	
	MIN.	12	39	65	95	131	156	
2 nd TORQUING	1H	28	66	101	145	209	237	
	2H	20	47	80	114	150	180	
	3H	19	59	81	118	154	189	
	4H	17	65	109	138	185	(93,600 PSI) 196(1)	
	5H	30	76	108	140	190	(1)	
	AVE.	23	63	95	131	178	200	
	MAX.	30	76	108	145	209	237	
	MIN.	17	47	80	114	150	170	
3 rd TORQUING	1H	31	81	117	158	204	232	
	2H	24	36	96	135	183	214	
	3H	30	70	106	148	192	225	
	4H	35	86	132	HEAD RUPTURED BY TOOL (1)			
	5H	40	95	131	176	225	(1)	
	AVE.	32	74	116	154	201	224	
	MAX.	40	95	132	176	225	232	
	MIN.	24	36	96	135	183	214	
4 th TORQUING	1H	31	84	130	176	225	253	
	2H	28	71	110	142	182	207	
	3H	32	83	129	169	224	(97,200 PSI) 241(1)	
	4H	TEST DISCONTINUED DUE TO RUPTURED HEAD RECESS						
	5H	42	113	171	HEAD RUPTURED ON TOOL (1)			
	AVE.	33	98	135	163	210	230	
	MAX.	42	113	171	176	225	253	
	MIN.	28	71	110	142	182	207	RUPTURED (116,000 PSI) 288
5 th TORQUING	1H	32	96	142	198	236	269	(116,000 PSI)
	2H	29	80	130	166	(82,000 PSI) 190	RUPTURED	HEAD (1)
	3H	37	102	156	195	(94,400 PSI) 228	"	" (1)
	4H	TEST DISCONTINUED DUE TO RUPTURED HEAD					RECESS	
	5H	"	"	"	"	"	"	
	AVE.	34	93	141	186	236	269	(116,000 PSI) 282
	MAX.	37	102	156	198	236	269	
	MIN.	29	80	130	166	236	269	

TORQUED FROM NUT

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	105,000 TORQUE (in-#)	THEORETICAL YIELD PT. 130,000 TORQUE (in-#)
1N	19	33	56	86	116	142	
2N	17	40	69	100	135	167	
3N	15	38	65	100	127	142	
4N	14	39	75	108	137	144	
5N	14	37	62	103	133	146	
AVE.	15	38	65	99	130	148	
MAX.	17	41	75	108	137	167	
MIN.	14	33	56	86	116	142	
1N	12	34	56	83	116	140	
2N	16	39	66	99	140	162	
3N	14	36	66	102	128	147	
4N	15	37	66	97	121	141	
5N	15	38	67	103	127	144	
AVE.	14	37	64	97	126	147	
MAX.	16	39	67	103	140	162	
MIN.	12	34	56	83	116	140	
1N	12	34	58	87	118	138	
2N	17	41	70	102	145	172	
3N	15	40	71	103	133	152	
4N	13	40	67	89	121	136	
5N	15	37	61	107	136	152	
AVE.	14	38	65	98	131	150	
MAX.	17	41	71	107	145	172	
MIN.	12	34	58	87	118	136	
1N	13	36	61	91	127	146	
2N	18	47	76	110	145	177	
3N	16	42	73	104	135	156	
4N	14	42	69	90	123	139	
5N	16	40	66	111	141	165	
AVE.	15	41	69	101	134	157	
MAX.	18	47	76	111	145	177	
MIN.	13	36	61	90	123	139	
1N	13	37	67	95	131	152	185
2N	21	52	85	116	156	187	225
3N	18	44	77	108	137	160	192
4N	19	49	70	91	116	140	191
5N	16	37	72	116	145	165	170
AVE.	16	43	74	105	137	161	193
MAX.	21	52	85	116	156	187	225
MIN.	13	37	67	91	116	140	170

LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	105,000 TORQUE (in-#)	THEORETICAL YIELD PT. 130,000 TORQUE (in-#)
1H-L	12	29	45	65	83	102	
2H-L	10	26	43	55	73	87	
3H-L	10	24	40	55	76	95	
4H-L	14	26	42	60	78	97	
5H-L	16	42	66	72	84	89	
AVE.	12	29	47	61	79	94	
MAX.	16	42	66	72	94	102	
MIN.	10	24	40	55	73	87	
1H-L	12	27	34	61	86	106	
2H-L	11	28	44	55	78	92	
3H-L	10	25	42	54	82	103	
4H-L	13	31	50	65	87	103	
5H-L	16	35	51	67	82	90	
AVE.	12	29	44	60	83	99	
MAX.	16	35	51	67	87	106	
MIN.	10	25	34	54	78	90	
1H-L	11	29	48	65	92	114	
2H-L	10	25	44	60	77	94	
3H-L	11	26	43	57	90	111	
4H-L	14	35	54	74	96	116	
5H-L	17	38	55	72	85	95	
AVE.	13	31	49	66	88	106	
MAX.	17	38	55	74	96	116	
MIN.	10	25	43	57	77	94	
1H-L	13	26	40	52	72	87	
2H-L	9	24	43	55	81	100	
3H-L	9	24	42	59	90	109	
4H-L	11	32	55	72	93	109	
5H-L	14	41	70	86	89	96	
AVE.	11	29	50	65	85	100	
MAX.	14	41	70	86	93	109	
MIN.	9	24	40	52	72	87	
1H-L	12	27	44	56	75	92	150
2H-L	10	25	44	64	86	106	150
3H-L	10	27	45	68	95	117	168
4H-L	13	35	58	81	106	127	186
5H-L	14	33	50	69	85	95	105
AVE.	12	29	48	68	89	107	182
MAX.	14	35	58	81	106	127	186
MIN.	10	25	44	56	75	92	105

TORQUED FROM NUT

SPECIMEN No.	TENSILE STRESS (#/in²) 10,000 TORQUE (in-#)	30,000 TORQUE (in-#)	50,000 TORQUE (in-#)	70,000 TORQUE (in-#)	90,000 TORQUE (in-#)	105,000 TORQUE (in-#)	THEORETICAL YIELD PT. 130,000 TORQUE (in-#)
1N-L	12	25	40	54	75	98	
2N-L	8	25	47	71	98	109	
3N-L	10	30	49	69	88	101	
4N-L	9	19	32	50	74	98	
5N-L	18	30	54	77	98	109	
AVE.	18	26	44	64	86	109	
MAX.	12	30	54	77	98	109	
MIN.	8	19	32	50	74	98	
1N-L	12	27	46	65	84	104	
2N-L	14	35	58	77	99	106	
3N-L	11	30	47	69	83	100	
4N-L	10	23	37	57	85	104	
5N-L	15	40	67	89	106	120	
AVE.	12	31	51	71	90	107	
MAX.	15	40	67	89	106	120	
MIN.	10	23	37	57	83	100	
1N-L	13	29	49	68	66	111	
2N-L	14	34	61	80	97	110	
3N-L	13	31	46	65	85	100	
4N-L	10	26	42	62	88	108	
5N-L	18	45	72	96	115	129	
AVE.	14	33	54	74	90	111	
MAX.	17	45	72	96	115	124	
MIN.	10	26	42	62	66	100	
1N-L	8	22	33	50	75	96	
2N-L	6	24	44	64	83	98	
3N-L	7	18	31	52	78	95	
4N-L	6	20	37	50	84	98	
5N-L	8	22	40	70	95	111	
AVE.	7	21	37	57	83	102	
MAX.	8	24	44	70	95	111	
MIN.	6	18	31	50	75	95	
1N-L	10	27	42	63	85	110	153
2N-L	12	34	55	73	90	100	184
3N-L	8	24	40	60	86	102	146
4N-L	8	25	45	74	89	104	136
5N-L	12	30	56	82	111	129	155
AVE.	10	28	48	70	92	109	134
MAX.	12	34	56	82	111	129	155
MIN.	8	24	40	60	85	102	136

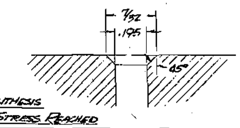
COMMENTS:
1. REMAINING PHILLIPS HEADS OF BOLTS 1-N TO 5H RUPTURED AS NOTED ABOVE. TESTS WERE DISCONTINUED WHEN FURTHER TORQUING COULD NOT BE ACHIEVED. RECESSED HEADS RUPTURED WITH VALUES OF TORQUE IN RANGE OF 190-270 IN-LB, AVERAGING ABOUT 225 IN-LB.
2. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT BEGINNING OF EACH TORQUING FOR INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT & HEAD BEARING SURFACES.
3. SPACER BLOCKS WERE REMADED AFTER 5TH TORQUING OF EACH SPECIMEN FOR DRY CONDITIONS ONLY DUE TO SCARRING. COUNTERSINK IN HEAD SPACER BLOCK WAS SANDED WITH EMERY CLOTH BY HAND.

DATE — 12 APRIL 1956
SIZE — A-A 10-32 NF 3A
SCREW OR BOLT — AN3C-30 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
NUT — AN363-C1032 " " FLEXLOC DIV. OF STANDARD PRESSED STEEL CO., JENKINTOWN, PA.

TEST CELL — No.
TORSION — 7B
COMPRESSION — 5A

TEST DATA
CONTRACT No AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPACING BLOCK. (ROCKWELL "C" SCALE 60)

A-A

NON LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	Tensile Stress (#/in²) 15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical Yield Pt. 111,000 Torque (in-#)
Initial Torquing	1H	14	40	66	101	140	173	
	2H	12	27	51	80	120	175	
	3H	15	34	59	92	134	190	
	4H	15	36	55	80	114	147	
	5H	16	36	54	79	109	159	
	AVE.	14	35	57	86	122	169	
	MAX.	16	40	66	101	140	190	
	MIN.	12	27	51	79	100	147	
2nd Torquing	1H	26	56	85	119	156	197	
	2H	24	50	72	104	140	194	
	3H	21	46	76	110	157	195	
	4H	24	47	72	102	134	162	
	5H	21	49	73	105	145	189	
	AVE.	23	50	76	108	146	187	
	MAX.	26	56	85	119	157	197	
	MIN.	21	46	72	162	134	162	
3rd Torquing	1H	26	57	94	128	163	210	
	2H	26	52	79	112	155	205	
	3H	24	52	89	128	167	206	
	4H	25	52	80	111	144	178	
	5H	24	52	84	119	155	197	
	AVE.	25	53	85	120	157	199	
	MAX.	26	57	94	128	167	210	
	MIN.	24	52	79	111	144	178	
4th Torquing	1H	28	62	102	142	180	227	
	2H	27	56	89	129	173	216	
	3H	27	60	96	140	184	215	
	4H	27	50	86	114	151	192	
	5H	30	59	88	129	160	210	
	AVE.	28	57	92	131	171	212	
	MAX.	30	62	102	142	184	227	
	MIN.	27	50	86	114	151	192	
5th Torquing	1H	34	66	112	156	202	233	254
	2H	29	60	91	135	180	222	257
	3H	30	63	101	148	194	229	271
	4H	28	59	92	126	161	201	272
	5H	31	59	95	132	175	222	274
	AVE.	30	61	98	139	182	221	266
	MAX.	34	66	112	156	202	233	274
	MIN.	28	59	91	126	161	201	254

NON LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	Tensile Stress (#/in²) 15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical Yield Pt. 111,000 Torque (in-#)
Initial Torquing	1N	10	17	29	44	59	79	
	2N	10	17	35	48	70	100	
	3N	13	28	42	59	77	102	
	4N	16	33	55	90	118	(82,100 PSI) 152 (1)	
	5N	14	23	36	40	41	RUN (2) DISCONTINUED	
	AVE.	13	24	39	56	73	94	
	MAX.	16	33	55	90	118	102	
	MIN.	10	17	29	40	41	79	
2nd Torquing	1N	10	19	31	44	60	75	
	2N	9	15	32	49	68	98	
	3N	17	35	55	74	99	124	
	4N	BOLT YIELDED AND BROKE AT END OF 1st TORQUING (1)						
	5N	16	29	35	41	47	58	
	AVE.	16	25	38	52	69	88	
	MAX.	17	35	55	74	99	124	
	MIN.	9	18	31	41	47	58	
3rd Torquing	1N	11	20	33	46	61	80	
	2N	11	21	36	52	70	100	
	3N	24	51	74	98	126	158	
	4N	(1)						
	5N	20	34	43	50	62	75	
	AVE.	17	32	47	62	80	103	
	MAX.	24	51	74	98	126	158	
	MIN.	11	20	33	46	61	75	
4th Torquing	1N	7	19	32	45	62	77	
	2N	12	25	42	59	75	104	
	3N	26	52	82	110	141	172	
	4N	(1)						
	5N	22	37	49	61	75	92	
	AVE.	17	33	51	69	88	112	
	MAX.	26	52	82	110	141	172	
	MIN.	7	19	32	45	62	77	
5th Torquing	1N	8	19	33	47	63	86	125
	2N	16	30	46	68	87	105	123
	3N	30	59	90	121	150	181	220
	4N	(1)						
	5N	22	41	57	67	82	102	153
	AVE.	19	37	57	76	96	119	155
	MAX.	30	59	90	121	150	181	220
	MIN.	8	19	33	47	63	86	123

LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	Tensile Stress (#/in²) 15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical Yield Pt. 111,000 Torque (in-#)
Initial Torquing	1H-L	L (5) 6	17	30	45	69	88	
	2H-L	10	17	31	41	56	72	
	3H-L	10	19	31	44	72	128	
	4H-L	16	24	33	41	59	74	
	5H-L	10	21	34	48	70	81	
	AVE.	10	20	32	44	65	89	
	MAX.	16	24	34	48	72	128	
	MIN.	6	17	30	41	56	72	
2nd Torquing	1H-L	9	20	30	44	63	76	
	2H-L	10	19	29	39	49	65	
	3H-L	11	15	26	37	38	42	
	4H-L	11	21	31	41	51	66	
	5H-L	11	22	36	52	65	74	
	AVE.	10	19	30	43	53	65	
	MAX.	11	22	36	52	65	76	
	MIN.	9	15	26	37	38	42	
3rd Torquing	1H-L	11	21	34	45	59	70	
	2H-L	10	19	30	41	52	67	
	3H-L	8	17	26	34	39	44	
	4H-L	10	21	32	40	50	65	
	5H-L	12	24	37	54	64	72	
	AVE.	10	20	32	43	53	64	
	MAX.	12	24	37	54	64	72	
	MIN.	8	17	26	34	39	44	
4th Torquing	1H-L	L 9	15	25	34	43	55	
	2H-L	L 7	13	24	32	40	59	
	3H-L	L 7	16	24	34	40	46	
	4H-L	L 9	20	31	44	55	74	
	5H-L	L 11	25	40	57	74	89	
	AVE.	9	18	29	40	50	65	
	MAX.	11	25	40	57	74	89	
	MIN.	7	13	24	32	40	46	
5th Torquing	1H-L	10	17	27	34	44	57	68
	2H-L	10	17	26	35	47	60	91
	3H-L	8	15	23	32	39	46	(97,700 PSI) 77 (3)
	4H-L	12	25	36	50	60	76	125
	5H-L	13	26	39	59	81	87	117
	AVE.	11	20	30	42	54	65	100
	MAX.	13	26	39	59	81	87	125
	MIN.	8	15	23	32	39	46	68

LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	Tensile Stress (#/in²) 15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical Yield Pt. 111,000 Torque (in-#)
Initial Torquing	1N-L	L (5) 7	17	31	60	78	83	
	2N-L	L 8	15	24	35	45	62	
	3N-L	L 6	14	21	34	46	60	
	4N-L	L 15	60	143	207	226	41 (4)	[illegible]
	5N-L	L 9	15	25	32	56	45	
	AVE.	8	15	25	40	56	62	
	MAX.	9	17	31	60	78	83	
	MIN.	6	14	21	32	45	45	
2nd Torquing	1N-L	8	21	39	58	72	73	
	2N-L	10	17	27	40	56	86	
	3N-L	7	16	27	39	52	67	
	4N-L	L 4	11	20	29	42	55	
	5N-L	5	10	20	27	36	47	
	AVE.	7	15	27	39	52	66	
	MAX.	10	21	39	58	72	86	
	MIN.	4	10	20	27	36	47	
3rd Torquing	1N-L	9	18	30	43	64	82	
	2N-L	8	18	30	41	54	84	
	3N-L	8	17	29	41	55	73	
	4N-L	9	15	25	35	54	60	
	5N-L	6	12	21	30	41	53	
	AVE.	8	16	27	38	54	70	
	MAX.	9	18	30	43	64	84	
	MIN.	6	12	21	30	41	53	
4th Torquing	1N-L	L 12	32	46	56	64	64	
	2N-L	L 6	11	20	30	41	69	
	3N-L	L 6	12	20	27	37	54	
	4N-L	L 6	13	21	33	43	55	
	5N-L	L 5	11	19	30	40	53	
	AVE.	7	16	25	35	45	59	
	MAX.	12	32	46	56	64	69	
	MIN.	5	11	19	27	37	53	
5th Torquing	1N-L	14	26	43	49	50	55	62
	2N-L	7	15	24	35	47	78	117
	3N-L	8	17	26	35	46	61	96
	4N-L	7	15	25	34	43	54	87
	5N-L	5	11	20	28	39	51	(96,600 PSI) 79 (3)
	AVE.	8	17	28	36	45	64	90
	MAX.	14	26	43	49	50	78	117
	MIN.	5	11	20	28	39	51	62

COMMENTS:

1. BOLT 4N YIELDED AND BROKE WHILE APPROACHING 6TH POINT OF FIRST TORQUING. TEST ON BOLT 4N DISCONTINUED.
2. BOLT 5N WAS NOT TORQUED TO 6TH POINT (90,000 PSI) AT END OF FIRST TORQUING TO PREVENT POSSIBLE YIELDING PRIOR TO 5TH TORQUING, BUT CONTINUED TO 6TH POINT ON SUBSEQUENT RUNS.
3. BOLTS 3H-L AND 5N-L YIELDED BEFORE ATTAINING THEORETICAL YIELD VALUE OF 111,000 PSI AT END OF 5TH TORQUING.
4. HIGH VALUES OF TORQUE FOR FIRST TORQUING OF BOLT 4N-L WAS BELIEVED TO BE CAUSED BY THREAD BURR. THIS RUN WAS NOT AVERAGED WITH OTHER BOLTS.
5. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
6. THE SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING FOR THE DRY CONDITIONS ONLY DUE TO SCARRING.

PAGE [illegible]

DATE — 17 APRIL 1956

SIZE — B-B, 1/4-28 UNF-3A

SCREW OR BOLT — AN4C-30 MFD. BY AERO SUPPLY MFG. CO., INC., CORRY, PA.

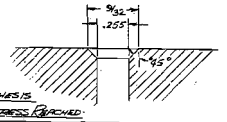
NUT — AN363-C428 " " ELASTIC STOP NUT CORP., UNION, N.J.

TEST CELL — No.
TORSION — TB
COMPRESSION — SA

TEST DATA

CONTRACT No. AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

B-B — NON LUBRICATED — TORQUED FROM HEAD

	Specimen No.	15,000 Torque (lbs-in)	30,000 Torque (lbs-in)	45,000 Torque (lbs-in)	60,000 Torque (lbs-in)	75,000 Torque (lbs-in)	90,000 Torque (lbs-in)	Theoretical Yield Point 111,000 Torque (lbs-in)
Initial Torquing	1H	51	74	96	130	189	271	
	2H	45	63	87	112	149	214	
	3H	38	63	94	135	203	289	
	4H	55	74	100	132	185	265	
	5H	47	71	99	79	173	225	
	Ave.	47	69	95	118	180	253	
	Max.	55	74	100	135	203	289	
	Min.	38	63	87	79	148	214	
2nd Torquing	1H	61	111	123	258	355	446	
	2H	68	105	157	204	266	367	
	3H	65	113	173	235	318	396	
	4H	86	149	215	300	378	462	
	5H	65	107	157	216	296	374	
	Ave.	69	117	177	243	323	409	
	Max.	86	149	215	300	378	462	
	Min.	61	105	157	204	266	367	
3rd Torquing	1H	84	150	220	300	387	482	
	2H	78	137	201	276	367	447	
	3H	84	159	241	324	406	491	
	4H	98	174	249	329	420	507	
	5H	84	150	220	305	381	463	
	Ave.	86	154	226	307	392	478	
	Max.	98	174	249	329	420	507	
	Min.	78	137	201	276	367	447	
4th Torquing	1H	85	159	235	315	410	508	
	2H	89	148	215	282	378	466	
	3H	90	171	286	350	427	523	
	4H	109	182	270	352	445	537	
	5H	94	168	250	331	418	515	
	Ave.	93	166	251	328	416	510	
	Max.	109	182	286	352	445	537	
	Min.	85	148	215	292	378	466	
5th Torquing	1H	94	165	249	333	430	532	647
	2H	87	155	225	302	394	481	620
	3H	99	174	263	363	483	541	650
	4H	115	192	280	377	467	542	705
	5H	107	180	268	355	453	551	665
	Ave.	100	193	236	344	437	529	657
	Max.	115	192	280	377	467	551	705
	Min.	87	155	225	302	394	481	620

B-B — NON LUBRICATED — TORQUED FROM NUT

	Specimen No.	15,000 Torque (lbs-in)	30,000 Torque (lbs-in)	45,000 Torque (lbs-in)	60,000 Torque (lbs-in)	75,000 Torque (lbs-in)	90,000 Torque (lbs-in)	Theoretical Yield Point 111,000 Torque (lbs-in)
Initial Torquing	1N	33	52	74	95	126	163	
	2N	35	55	76	96	114	140	
	3N	36	59	90	127	169	202	
	4N	35	50	69	89	111	145	
	5N	26	44	65	97	130	162	
	Ave.	33	52	75	101	130	162	
	Max.	36	59	90	127	169	202	
	Min.	26	44	65	89	111	140	
2nd Torquing	1N	33	50	67	89	124	165	
	2N	31	54	73	90	113	138	
	3N	35	56	81	115	154	202	
	4N	34	51	68	88	113	149	
	5N	26	41	64	89	117	150	
	Ave.	32	50	71	94	124	161	
	Max.	35	56	81	115	154	202	
	Min.	26	41	64	88	113	139	
3rd Torquing	1N	31	51	71	93	131	175	
	2N	33	55	75	94	121	153	
	3N	35	55	78	115	156	205	
	4N	35	53	70	92	122	157	
	5N	27	44	65	90	124	154	
	Ave.	32	52	72	97	131	169	
	Max.	35	55	78	115	156	205	
	Min.	27	44	65	90	121	153	
4th Torquing	1N	35	51	70	94	135	182	
	2N	37	59	81	102	127	160	
	3N	36	55	87	123	173	222	
	4N	36	54	74	95	121	169	
	5N	27	44	70	103	131	164	
	Ave.	34	53	76	103	137	177	
	Max.	37	59	87	123	173	222	
	Min.	27	44	70	94	121	154	
5th Torquing	1N	37	52	70	96	138	182	231
	2N	40	63	86	110	136	174	244
	3N	37	68	107	152	196	242	264
	4N	38	57	77	100	125	164	215
	5N	27	46	74	108	137	157	187
	Ave.	36	57	83	113	146	184	228
	Max.	40	68	107	152	196	242	264
	Min.	27	46	70	96	125	157	187

B-B — LUBRICATED — TORQUED FROM HEAD

	Specimen No.	15,000 Torque (lbs-in)	30,000 Torque (lbs-in)	45,000 Torque (lbs-in)	60,000 Torque (lbs-in)	75,000 Torque (lbs-in)	90,000 Torque (lbs-in)	Theoretical Yield Point 111,000 Torque (lbs-in)
Initial Torquing	1H-L	30	42	57	72	89	111	
	2H-L	41	62	83	109	131	164	
	3H-L	33	56	85	91	139	179	
	4H-L	37	60	85	91	145	175	
	5H-L	42	65	92	118	147	185	
	Ave.	37	57	80	96	130	163	
	Max.	42	65	92	118	147	185	
	Min.	30	42	57	72	89	111	
2nd Torquing	1H-L	70	46	64	84	106	134	
	2H-L	47	72	98	124	150	192	
	3H-L	40	67	91	117	120	176	
	4H-L	91	65	93	120	150	190	
	5H-L	93	69	91	121	145	180	
	Ave.	40	63	87	113	134	174	
	Max.	47	72	98	124	150	192	
	Min.	30	46	64	84	106	134	
3rd Torquing	1H-L	36	59	82	105	135	166	
	2H-L	46	89	118	141	159	196	
	3H-L	39	73	104	134	162	193	
	4H-L	49	79	120	166	209	258	
	5H-L	49	68	98	130	163	205	
	Ave.	45	74	104	135	166	204	
	Max.	56	89	120	166	209	258	
	Min.	36	59	82	105	135	166	
4th Torquing	1H-L	35	57	79	107	135	167	
	2H-L	40	52	72	93	120	153	
	3H-L	32	53	72	90	115	145	
	4H-L	39	61	81	103	189	155	
	5H-L	40	54	76	118	133	165	
	Ave.	39	55	76	102	126	157	
	Max.	40	61	81	118	135	167	
	Min.	32	52	72	90	115	145	
5th Torquing	1H-L	39	65	90	115	141	168	211
	2H-L	42	57	75	93	117	152	199
	3H-L	33	52	68	91	111	141	197
	4H-L	40	59	79	100	125	158	201
	5H-L	45	69	91	128	194	243	325
	Ave.	40	60	81	109	138	172	227
	Max.	45	69	91	128	194	243	325
	Min.	33	52	68	91	111	141	197

B-B — LUBRICATED — TORQUED FROM NUT

	Specimen No.	15,000 Torque (lbs-in)	30,000 Torque (lbs-in)	45,000 Torque (lbs-in)	60,000 Torque (lbs-in)	75,000 Torque (lbs-in)	90,000 Torque (lbs-in)	Theoretical Yield Point 111,000 Torque (lbs-in)
Initial Torquing	1N-L	32	49	67	84	106	124	
	2N-L	34	50	66	83	106	115	
	3N-L	31	46	62	80	100	123	
	4N-L	39	51	68	86	103	120	
	5N-L	35	47	65	79	102	125	
	Ave.	34	49	66	82	103	121	
	Max.	39	51	68	86	106	125	
	Min.	31	46	62	79	100	115	
2nd Torquing	1N-L	33	50	66	87	110	129	
	2N-L	31	45	60	75	94	113	
	3N-L	32	50	66	87	109	137	
	4N-L	35	54	69	88	107	129	
	5N-L	32	50	67	86	109	136	
	Ave.	33	50	66	85	106	129	
	Max.	35	54	69	88	110	137	
	Min.	31	45	60	75	94	113	
3rd Torquing	1N-L	36	56	77	101	123	142	
	2N-L	32	48	63	78	97	117	
	3N-L	35	50	67	91	111	145	
	4N-L	34	52	71	93	113	134	
	5N-L	33	50	71	91	113	140	
	Ave.	34	51	70	91	111	136	
	Max.	36	56	77	101	123	145	
	Min.	32	48	63	78	97	117	
4th Torquing	1N-L	33	51	65	82	101	140	
	2N-L	29	42	56	73	98	117	
	3N-L	29	43	57	75	96	120	
	4N-L	29	42	56	72	93	114	
	5N-L	28	41	57	73	109	141	
	Ave.	30	44	58	75	101	126	
	Max.	33	51	65	82	109	141	
	Min.	28	41	56	72	93	114	
5th Torquing	1N-L	38	60	81	106	123	140	160
	2N-L	33	46	62	77	99	122	149
	3N-L	34	51	71	91	111	135	170
	4N-L	30	50	66	86	105	127	158
	5N-L	31	48	59	74	111	131	156
	Ave.	33	51	68	87	110	131	159
	Max.	38	60	81	106	123	140	170
	Min.	30	46	59	74	99	122	149

COMMENTS:
1. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
2. THE SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING FOR THE DRY CONDITIONS ONLY DUE TO SCARRING.

PAGE 114

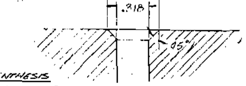
DATE —— 10 APRIL 1956
SIZE —— C-C, 5/16-24 UNF-3A
SCREW OR BOLT — AN 5C-35 MFTD. BY AERO BOLT & SCREW CO., STAMFORD CONN.
NUT —— AN 363-C524 " " FLEXLOC DIV. OF STANDARD PRESS STEEL CO., JENKINTOWN, PA.

TEST CELL No.
TENSION 7B
COMPRESSION 6B

TEST DATA

CONTRACT No. AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESIS
DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

C-C

NON LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	15,000 Torque (in.-#)	30,000 Torque (in.-#)	45,000 Torque (in.-#)	60,000 Torque (in.-#)	75,000 Torque (in.-#)	90,000 Torque (in.-#)	Theoretical Yeild Pt. 111,000 Torque (in.-#)
Initial Torquing	1H	69	148	238	325	445	614	
	2H	121	265	432	639	820	988	
	3H	127	248	400	522	640	755	
	4H	100	215	350	495	655	765	
	5H	118	210	320	430	545	767	
	Ave.	107	217	348	482	621	778	
	Max.	127	265	432	639	820	988	
	Min.	69	148	238	325	445	614	
2nd Torquing	1H	174	266	340	425	564	740	
	2H	150	285	415	540	670	780	
	3H	165	320	435	555	665	800	
	4H	175	322	455	588	712	800	
	5H	165	295	405	520	630	775	
	Ave.	166	298	410	526	648	779	
	Max.	175	322	455	588	712	800	
	Min.	150	266	340	425	564	740	
3rd Torquing	1H	171	295	427	571	727	892	
	2H	165	310	445	555	678	783	
	3H	178	322	455	578	700	825	
	4H	182	325	480	618	733	820	
	5H	172	300	442	547	645	795	
	Ave.	174	310	450	574	697	823	
	Max.	182	325	480	618	733	892	
	Min.	165	295	427	547	645	783	
4th Torquing	1H	165	325	490	640	795	967	
	2H	170	302	465	580	705	815	
	3H	180	325	455	582	715	752	
	4H	182	325	485	625	748	825	
	5H	165	325	450	567	685	828	
	Ave.	172	320	469	599	730	837	
	Max.	182	325	490	640	795	967	
	Min.	165	302	450	567	685	752	
5th Torquing	1H	172	337	495	666	826	992	(103,600 PSI) 1084 (1)
	2H	182	330	470	630	730	840	970
	3H	200	350	500	620	745	875	1075
	4H	195	350	501	628	750	847	1000
	5H	185	330	470	587	720	873	1052
	Ave.	187	339	491	626	754	885	1024
	Max.	200	350	501	666	826	992	1075
	Min.	172	330	470	587	720	840	970

NON LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	15,000 Torque (in.-#)	30,000 Torque (in.-#)	45,000 Torque (in.-#)	60,000 Torque (in.-#)	75,000 Torque (in.-#)	90,000 Torque (in.-#)	Theoretical Yeild Pt. 111,000 Torque (in.-#)
Initial Torquing	1N	69	142	207	275	346	432	
	2N	85	148	210	272	324	389	
	3N	115	173	244	310	390	491	
	4N	55	101	152	200	259	331	
	5N	86	150	222	287	328	371	
	Ave.	82	143	207	269	329	403	
	Max.	115	173	244	310	390	491	
	Min.	55	101	152	210	259	331	
2nd Torquing	1N	82	155	223	295	370	463	
	2N	110	195	271	332	390	452	
	3N	134	211	276	352	439	551	
	4N	74	135	196	252	317	483	
	5N	105	173	258	316	366	400	
	Ave.	101	174	245	309	376	470	
	Max.	134	211	276	352	439	551	
	Min.	74	135	196	252	317	400	
3rd Torquing	1N	105	184	265	340	415	485	
	2N	133	220	307	375	440	505	
	3N	138	215	294	385	480	590	
	4N	98	170	253	325	383	442	
	5N	132	212	290	359	410	451	
	Ave.	121	200	282	356	426	495	
	Max.	138	220	307	385	480	590	
	Min.	98	170	253	325	383	442	
4th Torquing	1N	114	189	278	355	437	525	
	2N	135	235	319	389	470	530	
	3N	198	238	330	427	533	625	
	4N	117	196	289	363	428	493	
	5N	134	227	310	384	439	474	
	Ave.	130	217	305	384	461	529	
	Max.	148	238	330	427	533	625	
	Min.	114	189	278	355	428	474	
5th Torquing	1N	121	215	300	391	470	552	620
	2N	138	227	340	422	502	563	665
	3N	153	239	341	445	530	654	758
	4N	122	215	313	399	465	543	619
	5N	139	225	323	399	455	493	530
	Ave.	135	224	323	409	484	561	638
	Max.	153	239	341	445	530	654	758
	Min.	121	215	300	394	455	493	530

LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	15,000 Torque (in.-#)	30,000 Torque (in.-#)	45,000 Torque (in.-#)	60,000 Torque (in.-#)	75,000 Torque (in.-#)	90,000 Torque (in.-#)	Theoretical Yeild Pt. 111,000 Torque (in.-#)
Initial Torquing	1H-L	L(2) 46	96	135	180	230	296	
	2H-L	L 67	112	147	190	212	297	
	3H-L	L 40	73	115	168	243	367	
	4H-L	L 69	109	157	207	255	302	
	5H-L	L 70	144	201	256	332	394	
	Ave.	58	107	151	200	254	331	
	Max.	70	144	201	256	332	394	
	Min.	40	73	115	168	212	296	
2nd Torquing	1H-L	L 55	92	140	150	183	232	
	2H-L	L 58	95	129	167	215	276	
	3H-L	L 60	108	145	169	210	263	
	4H-L	L 62	107	154	178	235	279	
	5H-L	L 69	132	192	245	305	364	
	Ave.	61	107	152	182	230	283	
	Max.	69	132	192	245	305	364	
	Min.	55	92	129	150	183	232	
3rd Torquing	1H-L	L 62	95	127	168	218	270	
	2H-L	L 66	97	132	182	229	275	
	3H-L	L 55	88	119	145	177	212	
	4H-L	L 64	102	150	180	222	264	
	5H-L	L 60	119	163	207	251	295	
	Ave.	61	100	138	176	219	263	
	Max.	66	119	163	207	251	295	
	Min.	55	88	119	145	177	212	
4th Torquing	1H-L	L 70	97	158	202	257	327	
	2H-L	L 57	91	131	170	215	269	
	3H-L	L 54	97	132	159	180	222	
	4H-L	L 60	100	140	177	219	262	
	5H-L	L 69	113	161	195	250	306	
	Ave.	61	100	144	180	224	277	
	Max.	70	113	161	202	257	327	
	Min.	54	91	131	154	180	222	
5th Torquing	1H-L	L 75	130	176	212	262	325	385
	2H-L	L 60	102	144	183	222	282	362
	3H-L	L 51	90	130	155	194	244	326
	4H-L	L 54	76	112	145	193	248	329
	5H-L	L 56	99	138	177	239	304	350
	Ave.	59	99	140	174	221	281	350
	Max.	75	130	176	212	262	325	385
	Min.	51	76	112	145	193	244	326

LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	15,000 Torque (in.-#)	30,000 Torque (in.-#)	45,000 Torque (in.-#)	60,000 Torque (in.-#)	75,000 Torque (in.-#)	90,000 Torque (in.-#)	Theoretical Yeild Pt. 111,000 Torque (in.-#)
Initial Torquing	1N-L	L(2) 28	57	89	111	138	172	
	2N-L	L 40	72	105	135	179	215	
	3N-L	L 31	58	86	115	144	178	
	4N-L	L 41	73	121	154	177	202	
	5N-L	L 35	63	90	123	159	203	
	Ave.	35	65	98	128	159	194	
	Max.	41	73	121	154	179	215	
	Min.	28	57	86	111	138	172	
2nd Torquing	1N-L	32	57	83	110	138	176	
	2N-L	L 34	59	78	122	142	205	
	3N-L	L 30	50	82	111	154	200	
	4N-L	L 31	62	109	141	167	200	
	5N-L	35	67	94	124	165	216	
	Ave.	32	59	89	122	153	199	
	Max.	35	67	109	141	167	216	
	Min.	30	50	78	110	138	176	
3rd Torquing	1N-L	L 22	45	74	97	131	179	
	2N-L	35	65	98	135	178	214	
	3N-L	L 23	45	72	106	136	169	
	4N-L	L 36	65	83	111	149	189	
	5N-L	L 35	56	82	107	136	181	
	Ave.	30	55	82	111	146	186	
	Max.	36	65	98	135	178	214	
	Min.	22	45	72	97	131	169	
4th Torquing	1N-L	30	59	87	117	150	194	
	2N-L	L 30	54	83	114	148	193	
	3N-L	L 27	47	76	102	133	175	
	4N-L	34	56	85	109	141	190	
	5N-L	40	70	96	122	151	194	
	Ave.	32	57	85	113	145	189	
	Max.	40	70	96	122	151	194	
	Min.	27	47	76	102	133	175	
5th Torquing	1N-L	L 24	47	78	109	127	162	211
	2N-L	35	65	93	124	160	205	278
	3N-L	L 26	46	72	105	137	148	236
	4N-L	L 34	62	90	119	152	202	260
	5N-L	29	48	78	115	175	218	257
	Ave.	30	54	82	114	150	187	248
	Max.	35	65	93	124	175	218	278
	Min.	24	46	72	105	127	148	211

COMMENTS:
1. BOLT 1H – HEAD BEGAN SLIPPING IN TOOL SOCKET AT END OF 5TH TORQUING. THEORETICAL YIELD POINT UNATTAINABLE. PARENTHESIS SHOWS TENSILE STRESS REACHED @ SLIPPING POINT.
2. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF EACH TORQUING FOR INITIAL LUBRICATION & SUBSEQUENT LUBRICATION OF NUT OR HEAD BEARING SURFACES.
3. THE SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING FOR THE DRY CONDITIONS ONLY DUE TO SCARRING.

PAGE 18

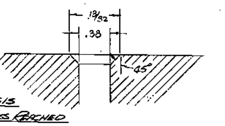
Date: 26 MARCH 1956
Size — D-D 3/8-24 UNF-3A
Screw or Bolt — AN 6C-36 MFTD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
Nut — AN 363 C-624 " " FLEXLOC DIV. OF STANDARD PRESS STEEL CO., JENKINTOWN, PA.

Test Cell – No.
Torsion – 7A&7B
Compression – 5B

TEST DATA

CONTRACT No. AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET CLEARANCE IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

D-D — NON LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical Yield Pt. 111,000 Torque (in-#)
Initial Torquing	1H	130	240	465	658	840	1150	
	2H	140	285	430	535	680	902	
	3H	125	255	468	748	1085	1520	
	4H	115	165	255	370	515	745	
	5H	125	265	400	655	875	1220	
	Ave.	127	242	404	593	799	1107	
	Max.	140	285	468	748	1085	1520	
	Min.	115	165	255	370	515	745	
2nd Torquing	1H	160	352	525	680	873	1130	
	2H	175	400	570	730	935	1145	
	3H	240	485	705	885	1052	1245	
	4H	180	320	475	632	810	985	
	5H	175	345	545	775	945	1205	
	Ave.	186	380	564	740	923	1142	
	Max.	240	485	705	885	1052	1245	
	Min.	160	320	475	632	810	985	
3rd Torquing	1H	168	345	545	752	960	1150	
	2H	165	370	535	745	950	1185	
	3H	285	520	695	905	1087	1300	
	4H	195	360	548	730	810	1100	
	5H	200	423	675	880	1110	1305	
	Ave.	203	404	600	802	983	1208	
	Max.	285	520	695	905	1110	1305	
	Min.	165	345	535	730	810	1100	
4th Torquing	1H	180	355	555	752	980	1125	
	2H	180	374	555	760	1000	1220	
	3H	270	510	710	940	1140	1765	
	4H	200	385	550	765	935	1138	
	5H	195	425	670	882	1102	1315	
	Ave.	205	410	608	820	1031	1313	
	Max.	270	510	710	940	1140	1765	
	Min.	180	355	550	752	935	1125	
5th Torquing	1H	180	373	560	765	985	1155	1475 (100,000 PSI)
	2H	165	375	550	755	1035	1260	1530 (1) (103,000 PSI)
	3H	250	475	700	955	1215	1817	1917 (2)
	4H	205	398	602	800	998	1185	1460 (3)
	5H	245	440	685	935	1150	1375	1605 (3)
	Ave.	209	412	619	842	1077	1358	1513
	Max.	250	475	700	955	1215	1817	1917
	Min.	165	373	550	755	985	1155	1475

D-D — NON LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical Yield Pt. 111,000 Torque (in-#)
Initial Torquing	1N	75	150	230	320	340	450	
	2N	85	170	260	345	465	570	
	3N	75	145	240	300	345	395	
	4N	65	150	245	345	370	483	
	5N	75	145	235	300	340	400	
	Ave.	75	152	242	322	372	448	
	Max.	85	170	260	345	465	570	
	Min.	65	145	230	300	340	395	
2nd Torquing	1N	100	185	250	335	418	510	
	2N	135	260	350	475	585	720	
	3N	85	170	260	310	355	418	
	4N	105	285	315	372	445	515	
	5N	100	170	248	300	358	465	
	Ave.	105	202	285	358	432	526	
	Max.	135	260	350	475	585	720	
	Min.	85	170	248	300	355	418	
3rd Torquing	1N	130	230	320	430	525	596	
	2N	175	320	420	510	625	748	
	3N	105	175	260	300	380	430	
	4N	165	290	435	508	570	660	
	5N	105	198	260	347	412	500	
	Ave.	136	243	339	419	502	587	
	Max.	175	320	435	510	625	748	
	Min.	105	175	260	300	380	430	
4th Torquing	1N	165	270	385	605	600	685	
	2N	195	330	465	580	705	845	
	3N	110	220	295	365	390	450	
	4N	230	380	505	595	650	770	
	5N	115	202	277	373	457	545	
	Ave.	163	280	385	484	560	659	
	Max.	230	380	505	595	705	845	
	Min.	110	202	277	365	390	450	
5th Torquing	1N	175	300	435	545	660	750	880
	2N	195	350	490	600	725	860	980
	3N	120	225	320	365	415	475	550
	4N	228	400	545	638	723	862	960
	5N	130	227	302	405	488	574	705
	Ave.	170	300	418	511	602	704	815
	Max.	228	400	545	638	725	862	980
	Min.	120	225	302	365	415	475	550

D-D — LUBRICATED — TORQUED FROM HEAD

Torquing No.	Specimen No.	15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical Yield Pt. 111,000 Torque (in-#)
Initial Torquing	1H-L	L (4) 25	62	108	170	235	305	
	2H-L	L 30	60	100	170	205	265	
	3H-L	L 35	80	125	175	220	300	
	4H-L	L 38	75	125	185	240	305	
	5H-L	L 37	80	105	162	225	305	
	Ave.	33	71	113	172	225	296	
	Max.	38	80	125	185	240	305	
	Min.	25	60	100	162	205	265	
2nd Torquing	1H-L	L 25	50	85	130	200	287	
	2H-L	L 25	45	85	125	185	250	
	3H-L	L 30	70	115	160	225	280	
	4H-L	L 50	80	115	168	225	277	
	5H-L	L 30	60	110	138	220	275	
	Ave.	32	61	102	144	211	274	
	Max.	50	80	115	168	225	287	
	Min.	25	45	85	125	185	250	
3rd Torquing	1H-L	55	125	205	285	350	425	
	2H-L	L 20	40	75	125	190	255	
	3H-L	L 40	75	132	182	230	282	
	4H-L	L 25	60	100	170	225	280	
	5H-L	L 25	65	100	150	215	273	
	Ave.	33	73	122	182	242	303	
	Max.	55	125	205	285	350	425	
	Min.	20	40	75	125	190	255	
4th Torquing	1H-L	L 55	120	170	225	285	355	
	2H-L	L 40	80	135	170	240	310	
	3H-L	L 25	70	110	165	230	280	
	4H-L	L 30	65	120	173	230	275	
	5H-L	L 30	60	118	175	225	277	
	Ave.	36	79	131	182	242	299	
	Max.	55	120	170	225	285	355	
	Min.	25	60	110	165	225	275	
5th Torquing	1H-L	L 50	85	150	205	265	370	445
	2H-L	L 30	65	80	130	190	275	365
	3H-L	L 30	70	115	135	215	268	395
	4H-L	L 30	65	120	175	230	278	377
	5H-L	L 25	70	115	170	200	277	377
	Ave.	33	71	116	163	220	294	392
	Max.	50	85	150	205	265	370	445
	Min.	25	65	80	130	190	268	365

D-D — LUBRICATED — TORQUED FROM NUT

Torquing No.	Specimen No.	15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical Yield Pt. 111,000 Torque (in-#)
Initial Torquing	1N-L	L (4) 35	82	127	170	225	270	
	2N-L	L 45	82	128	168	202	260	
	3N-L	L 35	75	115	170	210	250	
	4N-L	L 25	65	95	125	170	215	
	5N-L	L 30	70	110	150	220	250	
	Ave.	34	75	115	157	205	249	
	Max.	45	82	128	170	225	270	
	Min.	25	65	95	125	170	215	
2nd Torquing	1N-L	52	95	158	200	235	280	
	2N-L	40	72	118	145	205	280	
	3N-L	L 30	65	105	150	170	232	
	4N-L	L 25	50	100	135	175	225	
	5N-L	L 25	45	100	120	215	240	
	Ave.	34	65	116	150	200	251	
	Max.	52	95	158	200	235	280	
	Min.	25	45	100	120	170	225	
3rd Torquing	1N-L	60	108	162	220	255	275	
	2N-L	L 25	70	105	135	175	250	
	3N-L	50	90	138	170	210	245	
	4N-L	50	75	120	170	200	245	
	5N-L	45	70	123	168	218	257	
	Ave.	46	83	130	173	192	254	
	Max.	60	108	162	220	255	275	
	Min.	25	70	105	135	175	245	
4th Torquing	1N-L	L 30	55	100	152	198	258	
	2N-L	35	95	130	185	220	255	
	3N-L	L 35	70	120	140	178	210	
	4N-L	35	75	125	172	220	255	
	5N-L	45	95	150	200	225	255	
	Ave.	36	78	125	170	208	247	
	Max.	45	95	150	200	225	258	
	Min.	30	55	100	140	178	219	
5th Torquing	1N-L	52	120	178	227	265	302	375
	2N-L	45	95	150	188	245	285	400
	3N-L	50	70	158	170	218	255	335
	4N-L	L 25	45	73	125	170	225	285
	5N-L	L 25	65	100	125	173	230	335
	Ave.	39	79	132	167	214	259	346
	Max.	52	120	178	227	265	302	400
	Min.	25	45	73	125	170	225	285

COMMENTS:
1. Bolt 2H of non-lubricated bolts, torqued from head, received ruptured head by socket wrench (and socket wrench cracked) at end of 5th torquing while attempting to attain yield point of bolt. } Figures in parenthesis shows tensile stress reached.
2. Bolt 3H " " " " " " " " " " " " " " " " " " "
3. New heavy duty 9/16" sockets were purchased for bolts 4H & 5H.
4. Runs of lubricated torquings are marked with an "L" at the beginning of each torquing for initial lubrication & subsequent lubrications of nut or head bearing surfaces.
5. The spacer blocks were sanded after the 5th torquing for the dry conditions only due to scarring.

Page No.

WADC TR 57-330

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DATE 21 MARCH 1956

SIZE ——— E-E 7/16-20 UNF-3A

SCREW OR BOLT — AN 70-36 MFTD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.

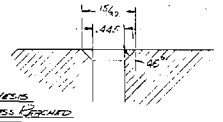
NUT ——— AN 363 C 720 " " FLEXLOC DIV. OF STANDARD PRESS STEEL CO., JENKINTOWN, PA.

TEST CELL — No
TEMPERATURE — 74° F
HUMIDITY — 58

TEST DATA

CONTRACT No AF 33(616)2808
P-1827

NOTE:
FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD FILLET REMAINING IN MACHINED STEEL SPACING BLOCK (ROCKWELL C - SCALE 60)

E-E

NON LUBRICATED

TORQUED FROM HEAD

TORQUING No.	SPECIMEN No.	15,000 TORQUE (in.-#)	30,000 TORQUE (in.-#)	45,000 TORQUE (in.-#)	60,000 TORQUE (in.-#)	75,000 TORQUE (in.-#)	90,000 TORQUE (in.-#)	THEORETICAL YIELD PT. 111,000 TORQUE (in.-#)
INITIAL TORQUING	1H	260	500	745	1258	1612	1955	
	2H	225	445	752	1235	1645	2078	
	3H	368	805	1180	1552	1880	2177	
	4H	250	525	885	1300	1780	2350	
	5H	200	400	645	960	1280	1635	
	AVE.	261	535	861	1261	1679	2019	
	MAX.	368	805	1180	1552	1880	2350	
	MIN.	200	400	645	960	1280	1635	
2ND TORQUING	1H	390	702	1025	1380	1700	2080	
	2H	335	675	1015	1370	1745	2020	
	3H	475	848	1150	1485	1790	2072	
	4H	365	700	1068	1475	1830	2155	
	5H	320	600	845	1075	1350	1680	
	AVE.	377	705	1020	1357	1683	2001	
	MAX.	475	848	1150	1485	1830	2155	
	MIN.	320	600	845	1075	1350	1680	
3RD TORQUING	1H	410	775	1135	1482	1798	2150	
	2H	325	740	1100	1428	1690	1975	
	3H	530	915	1225	1530	1825	2157	
	4H	425	795	1155	1530	1862	2175	
	5H	310	625	920	1250	1575	1910	
	AVE.	400	770	1167	1444	1750	2077	
	MAX.	530	915	1225	1530	1862	2175	
	MIN.	310	625	920	1250	1575	1910	
4TH TORQUING	1H	410	830	1195	1548	1985	2195 (1)	
	2H	350	770	1150	1472	1765	2022	
	3H	550	945	1295	1610	1955	2240	
	4H	405	770	1160	1545	1870	2212	
	5H	300	615	935	1255	1600	1940	
	AVE.	403	786	1147	1486	1835	2122	
	MAX.	550	945	1295	1610	1985	2240	
	MIN.	300	615	935	1255	1600	1940	
5TH TORQUING	1H	HEAD RUPTURED AT END OF 4TH TORQUING (1)						
	2H	460	710	1115	1830	1780	2025	2438
	3H	465	715	1112	1952	1825	2155	2468 (2)
	4H	395	760	1185	1500	1850	2185	2495
	5H	325	690	1000	1285	1635	1875	2430
	AVE.	391	719	1103	1418	1759	2060	2454
	MAX.	460	760	1185	1500	1850	2185	2495
	MIN.	325	690	1000	1285	1635	1875	2430

TORQUED FROM NUT

TORQUING No.	SPECIMEN No.	15,000 TORQUE (in.-#)	30,000 TORQUE (in.-#)	45,000 TORQUE (in.-#)	60,000 TORQUE (in.-#)	75,000 TORQUE (in.-#)	90,000 TORQUE (in.-#)	THEORETICAL YIELD PT. 111,000 TORQUE (in.-#)
INITIAL TORQUING	1N	100	205	333	389	485	582	
	2N	220	285	448	585	725	850	
	3N	110	210	325	402	477	570	
	4N	150	308	430	548	655	828	
	5N	195	360	525	645	795	895	
	AVE.	155	274	412	514	637	745	
	MAX.	220	360	525	645	795	895	
	MIN.	100	205	325	389	477	570	
2ND TORQUING	1N	112	225	337	432	528	623	
	2N	158	348	500	647	800	895	
	3N	112	210	320	400	470	555	
	4N	185	320	515	650	785	920	
	5N	205	382	540	675	824	920	
	AVE.	154	297	442	561	681	783	
	MAX.	205	382	540	675	824	920	
	MIN.	112	210	320	400	470	555	
3RD TORQUING	1N	185	232	368	487	570	660	
	2N	205	348	525	690	820	923	
	3N	115	225	330	402	475	575	
	4N	200	398	575	735	878	1010	
	5N	205	382	585	745	830	980	
	AVE.	170	317	477	612	714	830	
	MAX.	205	398	585	745	875	1010	
	MIN.	115	225	330	402	475	575	
4TH TORQUING	1N	150	295	442	547	630	720	
	2N	185	360	565	718	865	970	
	3N	125	245	328	415	500	580	
	4N	250	425	600	820	952	1075	
	5N	252	463	625	800	930	1030	
	AVE.	192	358	512	660	775	875	
	MAX.	252	463	625	820	952	1075	
	MIN.	125	245	328	415	500	580	
5TH TORQUING	1N	158	320	465	572	675	775	895
	2N	188	387	580	745	898	1000	1095
	3N	127	250	345	420	508	580	775
	4N	273	497	673	858	1032	1173	1303
	5N	210	435	620	805	933	1032	1110
	AVE.	191	378	537	680	809	912	1036
	MAX.	273	497	673	858	1032	1173	1303
	MIN.	127	250	345	420	508	580	775

LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	15,000 TORQUE (in.-#)	30,000 TORQUE (in.-#)	45,000 TORQUE (in.-#)	60,000 TORQUE (in.-#)	75,000 TORQUE (in.-#)	90,000 TORQUE (in.-#)	THEORETICAL YIELD PT. 111,000 TORQUE (in.-#)
1H-L	85	162	248	325	412	525	
2H-L	150	265	367	450	515	600	
3H-L	132	275	395	490	550	690	
4H-L	155	335	418	520	520	710	
5H-L	75	160	285	405	590	790	
AVE.	119	239	343	438	517	643	
MAX.	155	335	418	520	590	790	
MIN.	75	160	248	325	412	525	
1H-L	75	148	235	315	406	490	
2H-L	135	295	325	390	500	608	
3H-L	125	218	315	389	465	563	
4H-L	170	285	400	508	575	655	
5H-L	100	200	287	370	495	540	
AVE.	121	219	312	394	478	571	
MAX.	170	285	400	508	575	655	
MIN.	75	148	235	315	406	490	
1H-L	76	158	242	340	425	498	
2H-L	118	225	325	438	520	675	
3H-L	120	285	320	420	520	630	
4H-L	155	258	360	450	542	645	
5H-L	145	240	325	425	500	615	
AVE.	123	221	314	415	501	611	
MAX.	155	258	360	450	542	675	
MIN.	76	158	242	340	425	498	
1H-L	65	145	233	315	400	495	
2H-L	110	202	305	390	475	595	
3H-L	133	240	363	475	575	680	
4H-L	135	258	375	465	562	705	
5H-L	118	175	250	325	432	535	
AVE.	112	204	305	394	489	592	
MAX.	145	258	375	475	575	705	
MIN.	65	145	233	315	400	495	
1H-L	68	130	205	282	358	450	595
2H-L	125	220	340	430	490	630	995
3H-L	100	225	315	410	480	600	775
4H-L	162	325	495	550	675	845	1060
5H-L	140	250	390	490	532	500	610
AVE.	120	230	329	421	501	627	837
MAX.	168	325	445	550	675	845	1060
MIN.	68	130	205	282	358	450	595

TORQUED FROM NUT

SPECIMEN No.	15,000 TORQUE (in.-#)	30,000 TORQUE (in.-#)	45,000 TORQUE (in.-#)	60,000 TORQUE (in.-#)	75,000 TORQUE (in.-#)	90,000 TORQUE (in.-#)	THEORETICAL YIELD PT. 111,000 TORQUE (in.-#)
1N-L	75	162	230	292	355	475	
2N-L	90	150	215	275	322	387	
3N-L	75	150	220	300	350	425	
4N-L	86	140	225	285	332	425	
5N-L	112	200	262	327	388	469	
AVE.	88	160	230	296	349	435	
MAX.	112	200	262	327	388	469	
MIN.	75	140	215	275	322	387	
1N-L	88	170	239	297	363	490	
2N-L	90	150	210	275	323	380	
3N-L	65	123	187	270	330	405	
4N-L	66	125	187	270	337	420	
5N-L	75	129	210	277	308	420	
AVE.	77	138	206	278	332	419	
MAX.	90	170	239	297	363	490	
MIN.	65	123	187	270	308	380	
1N-L	102	175	233	325	392	468	
2N-L	95	133	220	296	327	401	
3N-L	70	135	200	270	340	420	
4N-L	73	150	210	295	357	445	
5N-L	112	185	260	325	375	458	
AVE.	90	156	225	300	358	498	
MAX.	112	185	260	325	392	468	
MIN.	70	133	200	270	327	401	
1N-L	70	120	175	295	325	382	
2N-L	95	135	182	255	315	368	
3N-L	75	150	220	295	350	440	
4N-L	55	100	162	250	315	400	
5N-L	75	126	200	273	335	411	
AVE.	74	124	188	264	324	400	
MAX.	95	150	220	295	350	440	
MIN.	55	100	162	245	305	368	
1N-L	88	153	232	287	356	435	530
2N-L	95	150	220	282	325	395	555
3N-L	65	135	235	300	365	425	520
4N-L	70	135	205	295	345	440	558
5N-L	98	175	245	295	345	440	550
AVE.	83	150	227	282	351	427	543
MAX.	98	175	245	300	365	440	558
MIN.	65	135	205	245	325	395	520

COMMENTS:
1. 1H BOLT OF NON-LUBRICATED BOLTS, TORQUED FROM HEAD, RECEIVED RUPTURED HEAD BY SOCKET WRENCH AT END OF 4TH TORQUING, PREVENTING SUCCESSIVE TORQUING.
2. 3H BOLT " " " " " " " " DID NOT REACH YIELD POINT AT END OF 5TH TORQUING BEFORE RUPTURE OF THE HEAD BY THE SOCKET DRIVE WRENCH.
3. RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF EACH TORQUING FOR INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
4. 11/16 SPACER BLOCKS WERE SANDED AFTER THE 5TH TORQUING FOR THE DRY CONDITIONS ONLY DUE TO STARRING.

WADC TR 57-330

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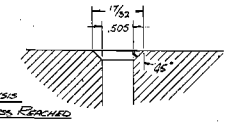
Test Cell – No:
Torsion – JAE78
Compression – 58

Date — March 14, 1956
Size — F-F 1/2 -20UNF-3A
Screw or Bolt — AN 8C-37 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
Nut — AN 363 C 820 " " " FLEXLOC DIV. OF STANDARD PRESS STEEL CO., JENKINTOWN, PA.

Test Data
Contract No. AF 33(616)2808
P-1227

Note:
Figures In Parenthesis Denote Tensile Stress Reached



Sketch Showing Head Fillet Clearance In Hardened Steel Spacing Blocks, (Rockwell "C" - Scale 60)

F-F

Non Lubricated

Torqued From Head

Torquing No.	Specimen No.	Tensile Stress (#/in²) 15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical 111,000 Yield Pt. Torque (in-#)
Initial Torquing	1H	335	700	1095	1630	2210	2915	
	2H	380	820	1290	1830	2365	2970	
	3H	350	720	1140	1645	2190	2825	
	4H	345	715 •	1085	1425	1890	3000	
	5H	340	765	1205	1735	2400	3285	
	Ave.	350	744	1155	1653	2211	2999	
	Max.	380	820	1290	1830	2400	3285	
	Min.	335	700	1095	1425	1890	2825	
2nd Torquing	1H	525	995	1465	1905	2420	3070	
	2H	435	990	1565	2100	2650	3155 (3)	
	3H	500	990	1520	2160	2680	3125	
	4H	535	1025	1475	1920	2425	2990	
	5H	760	1305	1740	2205	2650	3800	
	Ave.	551	1061	1553	2058	2565	3228	
	Max.	760	1305	1740	2205	2680	3800	
	Min.	435	990	1465	1905	2420	2990	
3rd Torquing	1H	520	1035	1575	2150	2695	3215	
	2H	Head Ruptured At End Of 2nd Torquing						
	3H	450	985	1495	2160	2765	3555	
	4H	690	1210	1660	2175	2650	3175	
	5H	725	1320	1790	2275	2775	3250	
	Ave.	594	1128	1630	2190	2721	3299	
	Max.	725	1320	1790	2275	2775	3555	
	Min.	450	985	1495	2150	2650	3175	
4th Torquing	1H	580	1165	1760	2300	2860	3355	
	2H	Head Ruptured At End Of 2nd Torquing						
	3H	575	1105	1795	2465	3065	3585	
	4H	755	1390	1900	2420	2895	3425	
	5H	735	1345	1875	2375	2815	3210	
	Ave.	661	1261	1833	2390	2909	3394	
	Max.	755	1390	1900	2465	3065	3585	
	Min.	575	1165	1760	2300	2815	3210	
5th Torquing	1H	595	1130	1735	2350	2950	3425	(98,300 PSI) 3470 (2)
	2H	Head Ruptured At End Of 2nd Torquing						(99,000 PSI) 3155 (2)
	3H	595	1225	1855	2530	3120	3725	(99,000 PSI) 4125 (1)
	4H	810	1385	1925	2475	2915	3475	(99,000 PSI) 3475 (1)
	5H	770	1395	1945	2420	2855	3245	(97,000 PSI) 3875 (1)
	Ave.	692	1284	1863	2449	2969	3467	(97,330 PSI) Failed
	Max.	810	1395	1945	2530	3120	3725	4125
	Min.	595	1130	1735	2350	2855	3245	3155

Torqued From Nut

Specimen No.	Tensile Stress (#/in²) 15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical 111,000 Yield Pt. Torque (in-#)
1N	220	435	645	860	1090	1370	
2N	250	440	615	800	1000	1215	
3N	225	425	625	815	1015	1195	
4N	260	485	680	875	1050	1235	
5N	215	385	560	750	960	1175	
Ave.	234	434	625	820	1023	1238	
Max.	260	485	680	875	1090	1370	
Min.	215	385	560	750	960	1175	
1N	310	575	810	1055	1275	1535	
2N	310	525	720	925	1115	1355	
3N	275	505	720	980	1135	1320	
4N	300	550	760	975	1165	1375	
5N	245	450	650	855	1055	1250	
Ave.	288	521	732	950	1140	1367	
Max.	310	575	810	1055	1275	1535	
Min.	245	450	650	855	1055	1250	
1N	325	620	900	1165	1410	1680	
2N	335	560	765	990	1200	1430	
3N	310	585	835	1070	1265	1850	
4N	320	595	835	1070	1285	1480	
5N	270	505	715	925	1105	1310	
Ave.	312	573	810	1044	1253	1870	
Max.	335	620	900	1165	1410	1680	
Min.	270	505	715	925	1105	1310	
1N	350	680	1000	1305	1565	1850	
2N	345	590	810	1040	1260	1490	
3N	325	600	870	1130	1355	1535	
4N	340	625	905	1165	1385	1600	
5N	295	530	760	975	1160	1370	
Ave.	331	605	869	1123	1325	1569	
Max.	350	680	1000	1305	1565	1850	
Min.	295	530	760	975	1160	1370	
1N	385	710	1065	1375	1660	1965	(98,000 PSI) 2210 (2)
2N	345	585	825	1075	1310	1560	(98,000 PSI) 2040 (2)
3N	360	655	930	1200	1435	1630	(99,000 PSI) 2025 (2)
4N	375	680	975	1240	1480	1705	(98,000 PSI) 2240 (2)
5N	310	560	790	1025	1215	1410	(100,000 PSI) 1750 (2)
Ave.	355	638	917	1183	1420	1650	(98,330 PSI) 2228 (2)
Max.	385	710	1065	1375	1660	1965	2240
Min.	310	560	790	1025	1215	1410	1750

Lubricated

Torqued From Head

Specimen No.	Tensile Stress (#/in²) 15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical 111,000 Yield Pt. Torque (in-#)
1H-L	175	285	440	555	705	885	
2H-L	245	450	590	685	805	900	
3H-L	230	395	555	690	835	970	
4H-L	255	410	525	610	720	820	
5H-L	290	435	610	730	860	990	
Ave.	239	399	544	654	785	913	
Max.	290	455	610	730	860	990	
Min.	175	285	440	555	705	820	
1H-L	250	420	540	690	860	1055	
2H-L	225	370	470	585	695	840	
3H-L	175	290	410	535	670	820	
4H-L	150	250	375	490	600	735	
5H-L	200	330	445	560	685	860	
Ave.	200	332	448	572	702	862	
Max.	250	420	540	690	860	1055	
Min.	150	250	375	490	600	735	
1H-L	195	300	435	530	650	795	
2H-L	200	325	430	530	665	830	
3H-L	165	275	415	525	660	830	
4H-L	140	250	365	480	595	735	
5H-L	175	300	420	540	660	825	
Ave.	175	290	413	521	646	807	
Max.	200	325	435	540	665	830	
Min.	140	250	365	480	595	735	
1H-L	175	275	420	490	575	745	
2H-L	200	330	450	575	705	900	
3H-L	150	260	385	500	635	795	
4H-L	110	200	315	435	535	690	
5H-L	175	300	425	555	685	855	
Ave.	162	273	399	511	627	797	
Max.	200	330	450	575	705	900	
Min.	110	200	315	435	535	690	
1H-L	165	250	375	480	575	705	1020
2H-L	185	225	300	400	545	650	900
3H-L	130	245	390	510	650	820	1075
4H-L	100	185	295	420	520	675	915
5H-L	190	320	495	570	700	880	1225
Ave.	146	245	368	484	599	754	1027
Max.	190	320	495	570	700	880	1225
Min.	100	185	295	420	520	650	900

Torqued From Nut

Specimen No.	Tensile Stress (#/in²) 15,000 Torque (in-#)	30,000 Torque (in-#)	45,000 Torque (in-#)	60,000 Torque (in-#)	75,000 Torque (in-#)	90,000 Torque (in-#)	Theoretical 111,000 Yield Pt. Torque (in-#)
1N-L	125	225	325	430	520	619	
2N-L	125	235	355	450	580	695	
3N-L	125	285	410	505	610	700	
4N-L	131	235	335	450	530	690	
5N-L	130	235	350	470	530	685	
Ave.	127	247	355	461	554	669	
Max.	131	285	410	505	610	700	
Min.	125	225	325	430	520	618	
1N-L	125	225	320	405	510	630	
2N-L	135	235	310	405	495	620	
3N-L	115	200	315	420	525	635	
4N-L	105	205	330	440	550	710	
5N-L	120	215	335	430	545	660	
Ave.	120	216	322	420	525	667	
Max.	135	235	335	440	550	710	
Min.	105	200	310	405	495	600	
1N-L	125	225	320	410	505	690	
2N-L	150	240	325	445	515	610	
3N-L	125	225	325	430	545	665	
4N-L	115	215	330	450	560	725	
5N-L	115	210	320	430	530	650	
Ave.	126	223	324	427	531	658	
Max.	150	240	330	450	560	725	
Min.	115	210	320	410	505	610	
1N-L	130	230	340	450	535	670	
2N-L	150	235	325	425	535	630	
3N-L	125	225	325	430	545	665	
4N-L	120	230	340	460	580	745	
5N-L	115	215	325	435	545	650	
Ave.	128	227	331	440	548	672	
Max.	150	235	340	460	580	745	
Min.	115	215	325	425	535	630	
1N-L	125	225	340	445	550	685	920
2N-L	135	225	350	445	545	640	875
3N-L	125	235	340	460	570	700	945
4N-L	90	185	315	405	540	685	935
5N-L	120	225	335	405	555	675	895
Ave.	119	219	336	400	552	677	924
Max.	135	235	350	460	570	700	945
Min.	90	185	315	405	540	660	875

Comments:
1. Non-Lubricated Bolts Torqued From Head Did Not Reach Yield Point At End Of 5th Torquing Before Rupture Or The Hex Head By The Socket Wrench.
2. Non-Lubricated Bolts Torqued From Nut Reached Yield Point Or Bolts Before Theoretical Value Of 111000 PSI Was Reached In 4 Out Of 5 Bolts.
3. 2H Bolt Head Was Ruptured By Socket Wrench At 5th Point Of 2nd Torquing, Preventing Further Torquing.
4. Run Of Lubricated Torquings Are Marked With An "L" At The Beginning Of The Run To Indicate Initial Lubrication And Subsequent Lubrications Of Nut Or Head Bearing Surfaces.
5. The Spacer Blocks Were Sanded After The 5th Torquing For The Dry Conditions Only Due To Scarring.

DATE — 30 JANUARY 1957

SIZE — G-G, 9/16-18 UNF-3A

SCREW OR BOLT — AN 9C-37 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.

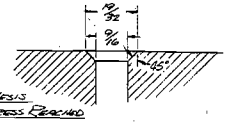
NUT — AN 363 C 918 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.

TEST CELL — No.
TORSION — 7A
COMPRESSION — 5C

TEST DATA

CONTRACT No. AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

G-G

NON LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	15,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	45,000 TORQUE (IN.-#)	60,000 TORQUE (IN.-#)	75,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	THEORETICAL YIELD POINT 111,000 TORQUE (IN.-#)
INITIAL TORQUING — TORQUING No.							
1H	735	1680	2525	3525	4550	5325	
2H	340	600	1180	2220	3040	3740	
3H	600	1220	1900	2700	3700	4640	
4H	300	600	1040	1700	2600	4000	
5H	700	1320	2300	3020	4100	5200	
AVE.	535	1084	1789	2633	3598	4581	
MAX.	735	1680	2525	3525	4550	5325	
MIN.	300	600	1040	1700	2600	3740	
2ND TORQUING							
1H	880	1935	2875	3850	4800	5625	
2H	700	1280	1700	2260	2860	3560	
3H	300	800	1320	2020	2800	3540	
4H	420	900	1500	2240	2900	3700	
5H	1040	1900	2740	3600	4500	5420	
AVE.	668	1463	2027	2794	3572	4369	
MAX.	1040	1935	2875	3850	4800	5625	
MIN.	300	800	1320	2020	2800	3540	
3RD TORQUING							
1H	1085	2150	3175	4115	5050	5520	
2H	660	1360	1920	2500	3360	4240	
3H	520	1200	2000	2880	3760	4780	
4H	420	920	1600	2300	3200	4000	
5H	1100	2260	3300	4200	4980	5640	
AVE.	757	1578	2399	3199	4070	4836	
MAX.	1100	2260	3300	4200	5050	5640	
MIN.	420	920	1600	2300	3200	4000	
4TH TORQUING							
1H	900	2000	2880	3780	4460	5200	
2H	800	1460	2180	2900	3700	4340	
3H	840	1700	2500	3560	4420	5340	
4H	500	1000	1800	2560	3360	4300	
5H	1200	2300	3300	4500	5340 (87,500 PSI)	5300 (4)	
AVE.	848	1692	2532	3460	4256	4795	
MAX.	1200	2300	3300	4500	5340	5340	
MIN.	500	1000	1800	2560	3360	4300	
5TH TORQUING							
1H	940	2040	3000	3820	4680	5410 (103,800 PSI)	6320
2H	800	1500	2300	3100	3900	4460 (92,700 PSI)	5460
3H	1000	1940	2920	3740	4600	5500 (101,600 PSI)	6160
4H	500	1100	1900	2700	3600	4420	5340
5H	TEST DISCONTINUED						
AVE.	810	1645	2530	3340	4195	4948	5400
MAX.	1000	2040	3000	3820	4680	5500	5460
MIN.	500	1100	1900	2700	3600	4420	5340

TORQUED FROM NUT

SPECIMEN No.	15,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	45,000 TORQUE (IN.-#)	60,000 TORQUE (IN.-#)	75,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	THEORETICAL YIELD POINT 111,000 TORQUE (IN.-#)
1N	425	765	1155	1515	1970	2405	
2N	640	1160	1690	2190	2730	3210	
3N	535	1005	1425	1810	2300	2850	
4N	650	1110	1655	2160	2600	3090	
5N	625	1200	1645	2175	2700	3200	
AVE.	575	1048	1510	1970	2460	2951	
MAX.	650	1200	1690	2190	2730	3210	
MIN.	425	765	1155	1515	1970	2405	
1N	590	1105	1535	1885	2250	2635	
2N	790	1490	2140	2625	3185	3690	
3N	635	1185	1690	2210	2720	3165	
4N	850	1500	1960	2400	2850	3265	
5N	825	1435	1910	2375	2800	3235	
AVE.	738	1343	1847	2299	2761	3198	
MAX.	850	1500	2140	2400	3185	3690	
MIN.	590	1105	1535	1885	2250	2635	
1N	725	1335	1835	2230	2625	2970	
2N	930	1635	2375	2990	3530	4060	
3N	750	1375	1950	2495	2980	3450	
4N	935	1575	2060	2515	3010	3415	
5N	840	1500	2090	2565	2950	3450	
AVE.	836	1484	2062	2559	3019	3469	
MAX.	935	1635	2375	2990	3530	4060	
MIN.	725	1335	1835	2230	2625	2970	
1N	765	1440	2000	2470	2865	3245	
2N	975	1835	2500	3200	3800	4250	
3N	750	1425	1985	2500	3025	3460	
4N	1000	1600	2135	2615	3075	3535	
5N	890	1625	2200	2700	3240	3655	
AVE.	876	1585	2164	2697	3221	3629	
MAX.	1000	1835	2500	3200	3800	4250	
MIN.	750	1425	1985	2470	2865	3245	
1N	900	1520	2150	2645	3090	3475	4005
2N	990	1780	2625	3290	3890	4460 (50 LT YIELDED (100,500 PSI) 3950)	4005
3N	685	1395	2025	2515	3100	3585 (100,500 PSI) 4000	4005
4N	995	1675	2285	2800	3240	3615 (94,300 PSI) 4040	4005
5N	900	1665	2265	2850	3375	3800	4005
AVE.	894	1607	2270	2820	3339	3787	4005
MAX.	995	1780	2625	3290	3890	4460	4005
MIN.	685	1395	2025	2515	3090	3475	4005

LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	15,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	45,000 TORQUE (IN.-#)	60,000 TORQUE (IN.-#)	75,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	THEORETICAL YIELD POINT 111,000 TORQUE (IN.-#)
1H-L	(a) 580	1025	1360	1805	2150	2660	
2H-L	290	515	815	1175	1600	2050	
3H-L	310	465	650	855	1135	1385	
4H-L	365	700	1100	1365	1835	2725	
5H-L	345	525	755	1110	1370	1675	
AVE.	378	646	936	1262	1618	2099	
MAX.	580	1025	1360	1805	2150	2725	
MIN.	290	465	650	855	1135	1385	
1H-L	340	625	865	1085	1360	1625	
2H-L	385	625	850	1140	1400	1675	
3H-L	315	455	640	800	995	1245	
4H-L	400	635	750	930	1125	1350	
5H-L	330	560	780	995	1225	1425	
AVE.	354	580	777	990	1221	1464	
MAX.	400	635	865	1140	1400	1675	
MIN.	315	455	640	800	995	1245	
1H-L	375	625	810	1015	1240	1520	
2H-L	375	590	805	1030	1245	1485	
3H-L	250	400	620	800	1015	1265	
4H-L	360	530	675	850	1025	1215	
5H-L	350	590	785	1005	1215	1440	
AVE.	342	547	739	940	1148	1385	
MAX.	375	625	810	1030	1245	1520	
MIN.	250	400	620	800	1015	1215	
1H-L	375	615	905	1170	1410	1670	
2H-L	385	550	765	960	1150	1375	
3H-L	295	460	605	765	960	1175	
4H-L	290	505	665	870	1075	1325	
5H-L	350	550	775	995	1170	1350	
AVE.	339	536	743	952	1153	1379	
MAX.	375	615	905	1170	1410	1670	
MIN.	290	460	605	765	960	1175	
1H-L	375	620	825	975	1185	1465	1915
2H-L	375	555	750	995	1230	1450	1915
3H-L	235	405	560	750	950	1155	1520
4H-L	315	515	700	855	1075	1285	1625
5H-L	300	470	645	825	1020	1270	1680
AVE.	320	513	696	880	1098	1325	1781
MAX.	375	620	825	995	1230	1465	1915
MIN.	235	405	560	750	950	1155	1520

TORQUED FROM NUT

SPECIMEN No.	15,000 TORQUE (IN.-#)	30,000 TORQUE (IN.-#)	45,000 TORQUE (IN.-#)	60,000 TORQUE (IN.-#)	75,000 TORQUE (IN.-#)	90,000 TORQUE (IN.-#)	THEORETICAL YIELD POINT 111,000 TORQUE (IN.-#)
1N-L	(a) 300	500	660	825	985	1140	
2N-L	300	515	770	995	1270	1465	
3N-L	275	475	690	885	1090	1285	
4N-L	325	550	730	930	1145	1350	
5N-L	285	475	650	850	1050	1235	
AVE.	297	503	700	897	1108	1295	
MAX.	325	550	770	995	1270	1465	
MIN.	275	475	650	885	985	1140	
1N-L	305	510	690	855	1040	1215	
2N-L	180	375	570	780	985	1250	
3N-L	175	325	500	700	900	1125	
4N-L	175	350	560	505	965	1215	
5N-L	195	380	595	795	985	1200	
AVE.	206	388	583	727	995	1201	
MAX.	305	510	690	855	1040	1250	
MIN.	175	325	500	505	900	1125	
1N-L	170	330	495	665	850	1015	
2N-L	175	370	560	785	1010	1240	
3N-L	155	325	510	695	915	1135	
4N-L	170	320	505	690	885	1105	
5N-L	175	375	555	750	950	1215	
AVE.	169	344	525	717	932	1142	
MAX.	175	375	560	785	1010	1240	
MIN.	155	320	495	665	850	1015	
1N-L	155	320	515	710	905	1125	
2N-L	170	350	520	725	950	1200	
3N-L	140	315	490	675	855	1080	
4N-L	140	315	495	680	880	1075	
5N-L	195	385	585	780	995	1250	
AVE.	160	337	517	714	917	1146	
MAX.	195	385	585	780	995	1250	
MIN.	140	315	490	675	855	1075	
1N-L	130	285	460	650	825	1020	1360
2N-L	165	325	500	700	905	1125	1510
3N-L	150	305	465	650	855	1055	1415
4N-L	165	335	510	690	890	1125	1510
5N-L	180	370	565	760	990	1225 (109,800 PSI) 1750	1510
AVE.	158	324	500	690	893	1110	1448
MAX.	180	370	565	760	990	1225	1510
MIN.	130	285	460	650	825	1020	1360

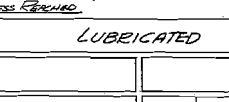
COMMENTS:
(1) STEEL SPACING BLOCKS HAD TO BE SANDED AFTER THE 5TH TORQUING OF EACH SPECIMEN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(2) SANDING OF THE SPACING BLOCKS AFTER THE 5TH TORQUING OF EACH SPECIMEN DURING DRY HEAD TORQUING CONDITIONS DID NOT REMOVE ALL MINOR SCRATCHES IN THE STEEL SPACING BLOCKS CAUSED BY SCARRING OF BOLT HEAD BEARING SURFACE.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION; SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.
(4) BOLT 5H YIELDED @ TENSILE VALUE NOTED. VALUE NOT USED IN AVERAGE. TEST DISCONTINUED.

DATE ——— 31 JANUARY, '57
SIZE ——— H-H, 5/8-18 UNF-3A
SCREW OR BOLT — AN 10C 37 MFD. BY ACED BOLT & SCREW CO., STAMFORD, CONN.
NUT ——— AN 363 C 1018 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.

TEST CELL — NO.
TORSION — 6B67A
COMPRESSION — 5C

TEST DATA
CONTRACT NO. AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAT COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

H-H

NON LUBRICATED — TORQUED FROM HEAD

INITIAL TORQUING NO.	SPECIMEN NO.	TENSILE STRESS (#/in²) 15,000 TORQUE (in-#)	30,000 TORQUE (in-#)	45,000 TORQUE (in-#)	60,000 TORQUE (in-#)	75,000 TORQUE (in-#)	90,000 TORQUE (in-#)	THEORETICAL YIELD POINT 111,000 TORQUE (in-#)
1H	1H	900	2080	3000	4320	6180	7260	
2H	2H (1)	700	1880	3100	4600	6300	7440	
3H	3H (1)	700	1840	3200	4600	6080	7040	
4H	4H	480	1600	2820	4080	5120	6180	
5H	5H (1)	940	1880	2880	4220	5600	6960	
	AVE.	744	1856	3000	4364	5856	6976	
	MAX.	940	2080	3200	4600	6300	7440	
	MIN.	480	1600	2820	4080	5120	6180	
2 ND TORQUING	1H	1440	2520	3440	4560	5620	6740	
	2H	1460	2680	3960	4780	5700	6500	
	3H	1220	2400	3540	4580	5600	6500	
	4H	1140	2300	3540	4740	5940	6980	
	5H	1460	2600	3740	4860	6000	7100	
	AVE.	1344	2500	3644	4704	5772	6764	
	MAX.	1460	2680	3960	4860	6000	7100	
	MIN.	1140	2300	3440	4560	5600	6500	
3 RD TORQUING	1H	1500	2700	3920	5060	6160	7140	
	2H	1200	2440	3600	4760	5640	6640	
	3H	1400	2540	3680	4840	6240	7200	
	4H	1300	2460	3820	5040	6100	6920	
	5H	1500	2700	3900	5140	6320	7160	
	AVE.	1380	2568	3784	4968	6092	7012	
	MAX.	1500	2700	3920	5140	6320	7200	
	MIN.	1200	2440	3600	4760	5640	6640	
4 TH TORQUING	1H	1400	2800	4100	5160	6260	7100	
	2H	1220	2420	3640	4580	5540	6420	
	3H	1400	2700	3960	5100	6240	7100	
	4H	1200	2700	3920	5200	6300	7100	
	5H	1400	2720	3860	5060	6040	7000	
	AVE.	1324	2668	3896	5020	6076	6944	
	MAX.	1400	2800	4100	5200	6300	7100	
	MIN.	1200	2420	3640	4580	5540	6420	
5 TH TORQUING	1H	1600	2840	3980	5120	6120	7020	8260
	2H	1220	2680	3800	4800	5720	6840	7960
	3H	1480	2920	4140	5600	6560	7440	8540
	4H	1500	2760	4080	5400	6600	7340	8660
	5H	1400	2800	4000	5240	6080	7040	8760
	AVE.	1440	2800	4000	5232	6416	7136	8436
	MAX.	1600	2920	4140	5600	6600	7440	8760
	MIN.	1220	2680	3800	4800	5720	6840	7960

NON LUBRICATED — TORQUED FROM NUT

SPECIMEN NO.	TENSILE STRESS (#/in²) 15,000 TORQUE (in-#)	30,000 TORQUE (in-#)	45,000 TORQUE (in-#)	60,000 TORQUE (in-#)	75,000 TORQUE (in-#)	90,000 TORQUE (in-#)	THEORETICAL YIELD POINT 111,000 TORQUE (in-#)
1N	660	1300	1800	2300	2820	3300	
2N	800	1460	2100	2700	3400	4020	
3N	1040	1880	2400	3000	3560	4100	
4N	780	1340	1960	2640	3200	3620	
5N	700	1160	1700	2260	2800	3500	
AVE.	796	1428	1992	2580	3156	3708	
MAX.	1040	1880	2400	3000	3560	4100	
MIN.	660	1160	1700	2260	2800	3300	
1N	800	1300	1820	2460	3100	3600	
2N	800	1560	2260	2900	3500	4120	
3N	1180	1900	2660	3300	3900	4600	
4N	740	1400	2160	2800	3340	3800	
5N	700	1380	2000	2600	3020	3440	
AVE.	844	1508	2180	2812	3372	3912	
MAX.	1180	1900	2660	3300	3900	4600	
MIN.	700	1300	1820	2460	3020	3440	
1N	740	1400	2000	2600	3220	3700	
2N	940	1780	2420	3220	3860	4480	
3N	1300	2200	3020	3860	4520	5140	
4N	800	1560	2240	2960	3560	4100	
5N	720	1460	2180	2740	3220	3740	
AVE.	900	1680	2372	3276	3676	4232	
MAX.	1300	2200	3020	3860	4520	5140	
MIN.	720	1400	2000	2600	3220	3700	
1N	740	1460	2140	2880	3620	4260	
2N	1000	1980	2800	3540	4200	4900	
3N	1400	2420	3360	4260	5020	5680	
4N	840	1700	2440	3200	3860	4400	
5N	860	1600	2300	3000	3420	3900	
AVE.	968	1832	2608	3376	4024	4628	
MAX.	1400	2420	3360	4260	5020	5680	
MIN.	740	1460	2140	2880	3420	3900	
1N	800	1600	2320	3000	3740	4360	5400
2N	1040	1900	2780	3560	4280	5100	5900
3N	1560	2640	3700	4560	5340	6000	6880
4N	1000	1740	2600	3340	4000	4600	5580
5N	860	1600	2360	3000	3580	4160	5080
AVE.	1052	1796	2752	3492	4188	4844	5768
MAX.	1560	2640	3700	4560	5340	6000	6880
MIN.	800	1600	2320	3000	3580	4160	5080

LUBRICATED — TORQUED FROM HEAD

SPECIMEN NO.	TENSILE STRESS (#/in²) 15,000 TORQUE (in-#)	30,000 TORQUE (in-#)	45,000 TORQUE (in-#)	60,000 TORQUE (in-#)	75,000 TORQUE (in-#)	90,000 TORQUE (in-#)	THEORETICAL YIELD POINT 111,000 TORQUE (in-#)
1H-L (1)	260	460	700	1000	1200	1840	
2H-L	260	460	660	980	1320	1880	
3H-L	280	500	760	1020	1320	1700	
4H-L	380	600	900	1200	1500	2000	
5H-L	260	500	760	1060	1400	1800	
AVE.	288	504	756	1052	1348	1844	
MAX.	380	600	900	1200	1500	2000	
MIN.	260	460	660	980	1320	1700	
1H-L	320	580	800	1100	1380	1700	
2H-L	320	520	800	1040	1380	1760	
3H-L	320	540	780	1000	1280	1600	
4H-L	460	700	900	1200	1500	1880	
5H-L	380	600	800	1160	1500	1900	
AVE.	360	588	816	1100	1408	1768	
MAX.	460	700	900	1200	1500	1900	
MIN.	320	520	780	1000	1280	1600	
1H-L	360	600	900	1120	1360	1660	
2H-L	280	480	700	940	1260	1520	
3H-L	300	560	840	1140	1460	1800	
4H-L	380	640	1000	1300	1640	1940	
5H-L	440	760	1000	1300	1600	1900	
AVE.	352	608	888	1160	1464	1764	
MAX.	440	760	1000	1300	1640	1940	
MIN.	280	480	700	940	1260	1520	
1H-L	360	540	720	1020	1260	1560	
2H-L	260	480	760	1020	1300	1600	
3H-L	300	600	840	1100	1360	1640	
4H-L	400	700	900	1200	1500	1800	
5H-L	360	660	1000	1300	1660	1960	
AVE.	336	596	844	1128	1416	1712	
MAX.	400	700	1000	1300	1660	1960	
MIN.	260	480	720	1020	1260	1560	
1H-L	340	560	800	1100	1320	1640	2140
2H-L	280	500	720	940	1240	1500	2000
3H-L	340	560	840	1100	1380	1660	2220
4H-L	360	620	900	1200	1500	1740	2240
5H-L	340	600	900	1200	1500	1800	2240
AVE.	332	568	832	1108	1388	1668	2168
MAX.	360	620	900	1200	1500	1800	2240
MIN.	280	500	720	940	1240	1500	2000

LUBRICATED — TORQUED FROM NUT

SPECIMEN NO.	TENSILE STRESS (#/in²) 15,000 TORQUE (in-#)	30,000 TORQUE (in-#)	45,000 TORQUE (in-#)	60,000 TORQUE (in-#)	75,000 TORQUE (in-#)	90,000 TORQUE (in-#)	THEORETICAL YIELD POINT 111,000 TORQUE (in-#)
1N-L (2)	300	500	700	900	1160	1360	
2N-L	340	540	720	900	1120	1240	
3N-L	340	560	780	980	1160	1860	
4N-L	340	580	800	1040	1240	1460	
5N-L	360	700	900	1000	1300	1360	
AVE.	336	576	780	964	1196	1356	
MAX.	360	700	900	1040	1300	1460	
MIN.	300	500	700	900	1120	1240	
1N-L	240	420	620	820	1100	1300	
2N-L	260	460	700	980	1160	1440	
3N-L	260	440	640	860	1100	1360	
4N-L	240	440	660	900	1180	1400	
5N-L	260	480	700	1000	1240	1540	
AVE.	252	448	664	912	1156	1408	
MAX.	260	480	700	1000	1240	1540	
MIN.	240	420	620	820	1100	1300	
1N-L	200	400	600	880	1140	1420	
2N-L	220	420	640	900	1120	1380	
3N-L	200	400	640	900	1140	1420	
4N-L	200	400	620	860	1100	1380	
5N-L	240	480	700	980	1240	1460	
AVE.	212	420	640	904	1148	1412	
MAX.	240	480	700	980	1240	1460	
MIN.	200	400	600	860	1100	1380	
1N-L	200	400	600	840	1100	1360	
2N-L	240	440	660	900	1140	1400	
3N-L	240	420	600	860	1100	1360	
4N-L	200	400	640	900	1160	1440	
5N-L	260	500	700	980	1200	1500	
AVE.	228	432	640	896	1140	1412	
MAX.	260	500	700	980	1200	1500	
MIN.	200	400	600	840	1100	1360	
1N-L	200	400	600	820	1100	1380	1900
2N-L	220	460	700	1020	1300	1540	1920
3N-L	200	400	600	860	1140	1460	1860
4N-L	200	400	620	900	1180	1460	1900
5N-L	240	480	700	900	1200	1500	2000
AVE.	212	428	644	900	1184	1468	1916
MAX.	240	480	700	1020	1300	1540	2000
MIN.	200	400	600	820	1100	1380	1860

COMMENTS:
(1) THE SECOND THRU FIFTH SPECIMENS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE RUN ON SCARRED SPACER BLOCK WHICH BECAME PROGRESSIVELY MORE SCARRED AND COULD NOT BE SANDED SMOOTH.
(2) SPACER BLOCKS WERE SANDED AFTER EACH SPECIMEN RUN FOR THE LUBERATED CONDITIONS AS WELL AS DRY DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION & SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

DATE — 11 FEBRUARY '57
SIZE — I-I, 3/4-16 UNF-3A
SCREW OR BOLT — AN 12C-41 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
NUT — AN 363-C 1216 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CORP., JENKINTOWN, PA.

TEST CELL – No.
TENSION – GB87A
COMPRESSION – 5C

TEST DATA

CONTRACT No. AF 33(616) 2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED

(Sketch dimensions: 25/32, 3/4, 45°)

SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" SCALE 60)

I-I — NON LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); Torque (in.-#)

Torquing No.	Specimen No.	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1H	1300	2560	4500	7340	9200		
	2H	(1) 540	3540	5180	7800	10560		
	3H	(1) 2360	4700	7240	9160	11000		
	4H	(1) 2140	[illegible]40	6700	8900	11340		
	5H	(1) 1420	3400	5540	7320	9600		
	AVE.	1752	3728	5832	8104	10340		
	MAX.	2360	4700	7240	9160	11340		
	MIN.	1300	2560	4500	7320	9200		
2nd Torquing	1H	1980	3340	5940	8100	10500		
	2H	2540	4700	6640	8440	10200		
	3H	2900	5300	7240	9000	10880		
	4H	2800	5380	7660	9500	11040		
	5H	2060	4100	6080	8060	10180		
	AVE.	2456	4564	6712	8620	10560		
	MAX.	2900	5380	7660	9500	11040		
	MIN.	1980	3340	5940	8060	10180		
3rd Torquing	1H	2500	4600	7000	8800	10240		
	2H	2360	4580	6400	8100	9600		
	3H	3000	5200	7260	9800	10900		
	4H	2800	5400	7860	9560	11200		
	5H	2100	4340	6300	8560	10680		
	AVE.	2552	4824	6964	8964	10524		
	MAX.	3000	5400	7860	9800	11200		
	MIN.	2100	4340	6300	8100	9600		
4th Torquing	1H	2340	4720	6860	8600	10320		
	2H	2420	4440	6480	8400	10100		
	3H	3100	5400	7600	9500	11160		
	4H	3040	5940	7940	9740	11740		
	5H	2260	4260	6540	8360	10600		
	AVE.	2632	4952	7084	8920	10784		
	MAX.	3100	5940	7940	9740	11740		
	MIN.	2260	4260	6480	8360	10100		
5th Torquing	1H	2680	5340	7460	9200	10800		
	2H	2600	4700	6760	8800	10440		
	3H	2980	5440	7600	9660	11300		
	4H	3080	5500	7660	9880	11700		
	5H	2100	4640	6940	8640	11100	13760	← Signs of approaching bolt yield
	AVE.	2688	5124	7284	9236	11068		
	MAX.	3080	5500	7660	9880	11700		
	MIN.	2100	4640	6760	8640	10440		

I-I — NON LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); Torque (in.-#)

Torquing No.	Specimen No.	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1N	720	1500	2500	3500	4320	5440	
	2N	600	1320	2420	3520	4700	5920	
	3N	1600	3000	4100	5460	6840	8900	
	4N	400	860	1200	1600	2200	3000	
	5N	720	1600	2600	3600	4400	4960	
	AVE.	808	1656	2564	3536	4492	5644	
	MAX.	1600	3000	4100	5460	6840	8900	
	MIN.	400	860	1200	1600	2200	3000	
2nd Torquing	1N	1120	2400	3500	4500	5500	6600	
	2N	860	1880	2860	4100	5160	6380	
	3N	2000	3720	5400	7180	8720	9800	
	4N	980	1920	3220	4500	5660	6700	
	5N	980	1900	3000	3900	4780	5360	
	AVE.	1188	2364	3596	4836	5964	6968	
	MAX.	2000	3720	5400	7180	8720	9800	
	MIN.	860	1880	2860	3900	4780	5360	
3rd Torquing	1N	1500	3000	4060	5100	6000	7500	
	2N	900	1920	2940	4000	5040	6100	
	3N	2000	3880	6180	7960	8980	10160	
	4N	1020	2340	3540	4820	6040	7040	
	5N	1200	2280	3480	4460	5200	5940	
	AVE.	1336	2684	4040	5268	6252	7348	
	MAX.	2060	3880	6180	7960	8980	10160	
	MIN.	900	1920	2940	4000	5040	5940	
4th Torquing	1N	1660	3160	4300	5440	6780	8000	
	2N	960	1940	3100	4140	5140	6100	
	3N	2300	4680	6440	7700	8900	9900	
	4N	1120	2200	3660	5000	6160	7100	
	5N	1320	2540	3740	4800	5700	6560	
	AVE.	1472	2904	4248	5416	6536	7532	
	MAX.	2300	4680	6440	7700	8900	9900	
	MIN.	960	1940	3100	4140	5140	6100	
5th Torquing	1N	1740	3380	4560	5800	7160	8660	10,500
	2N	1000	2060	3240	4380	5460	6300	8020
	3N	2360	4600	6260	7760	9040	10220	← BOLT YIELDED
	4N	1200	2400	3880	5220	6340	7380	8600
	5N	1400	2900	4000	5120	6200	7180	9400
	AVE.	1540	3068	4388	5656	6840	7948	9130
	MAX.	2360	4600	6260	7760	9040	10220	10500
	MIN.	1000	2060	3240	4380	5460	6300	8020

I-I — LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); Torque (in.-#)

Torquing No.	Specimen No.	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1H-L	(3) L 480	1060	2200	3740	5600	8700	
	2H-L	L 340	800	1700	3040	5000	6800	
	3H-L	L 380	1060	2160	3500	4860	6540	
	4H-L	L 340	720	1620	2640	3900	5700	
	5H-L	L 400	1000	2300	3860	5360	7600	
	AVE.	388	928	1996	3356	4944	7068	
	MAX.	480	1060	2300	3860	5600	8700	
	MIN.	340	720	1620	2640	3900	5700	
2nd Torquing	1H-L	L 700	1220	1700	2120	2600	3060	
	2H-L	L 720	1140	1440	1900	2240	2600	
	3H-L	L 500	920	1340	1720	2260	2800	
	4H-L	L 620	1120	1500	1900	2340	2800	
	5H-L	L 680	1340	1760	2240	2740	3340	
	AVE.	644	1148	1548	1976	2436	2920	
	MAX.	720	1340	1760	2240	2740	3340	
	MIN.	500	920	1340	1720	2240	2600	
3rd Torquing	1H-L	L 500	900	1400	1980	2460	2840	
	2H-L	L 460	800	1200	1640	2000	2460	
	3H-L	L 500	900	1300	1700	2100	2800	
	4H-L	L 600	1000	1420	1800	2260	2900	
	5H-L	L 660	1140	1500	1860	2300	2900	
	AVE.	544	948	1364	1796	2224	2780	
	MAX.	660	1140	1500	1980	2460	2900	
	MIN.	460	800	1200	1640	2000	2460	
4th Torquing	1H-L	L 400	800	1340	1820	2400	2980	
	2H-L	L 460	980	1780	1960	2160	2660	
	3H-L	L 500	860	1300	1700	2200	2700	
	4H-L	L 540	900	1300	1620	2100	2540	
	5H-L	L 500	1100	1600	2080	2500	3000	
	AVE.	480	928	1464	1836	2272	2776	
	MAX.	540	1100	1780	2080	2500	3000	
	MIN.	400	800	1300	1620	2100	2540	
5th Torquing	1H-L	L 460	800	1280	1760	2260	2780	3580
	2H-L	L 400	720	1100	1540	2000	2460	3140
	3H-L	L 500	860	1260	1720	2200	2720	3600
	4H-L	L 520	1000	1460	1800	2200	2600	3500
	5H-L	L 600	1100	1520	1940	2400	2860	4200
	AVE.	498	896	1324	1752	2212	2684	3604
	MAX.	600	1100	1520	1940	2400	2860	4200
	MIN.	400	720	1100	1540	2000	2460	3140

I-I — LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); Torque (in.-#)

Torquing No.	Specimen No.	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1N-L	(3) L 720	1160	1600	2000	2460	2800	
	2N-L	L 540	1080	1600	2140	2640	2980	
	3N-L	L 720	1460	2060	2520	2900	3360	
	4N-L	L 740	1340	1960	2480	2940	3400	
	5N-L	L 740	1300	2100	2500	2900	3260	
	AVE.	692	1268	1864	2328	2768	3160	
	MAX.	740	1460	2100	2520	2940	3400	
	MIN.	540	1080	1600	2000	2460	2800	
2nd Torquing	1N-L	L 500	980	1300	1700	2240	2780	
	2N-L	L 420	760	1220	1700	2300	2980	
	3N-L	L 440	840	1300	1860	2240	2900	
	4N-L	L 360	840	1320	1940	2560	3300	
	5N-L	L 400	700	1100	1600	2160	2740	
	AVE.	424	824	1248	1760	2300	2940	
	MAX.	500	980	1320	1940	2560	3300	
	MIN.	360	700	1100	1600	2160	2740	
3rd Torquing	1N-L	L 360	780	1260	1560	2000	2600	
	2N-L	L 360	740	1180	1660	2160	2600	
	3N-L	L 420	760	1160	1600	2100	2540	
	4N-L	L 400	800	1260	1760	2280	2900	
	5N-L	L 400	720	1160	1560	2140	2800	
	AVE.	388	760	1204	1628	2136	2688	
	MAX.	420	800	1260	1760	2280	2900	
	MIN.	360	720	1160	1560	2000	2540	
4th Torquing	1N-L	L 420	700	1060	1400	1940	2500	
	2N-L	L 380	760	1160	1560	2040	2500	
	3N-L	L 440	800	1260	1740	2280	2800	
	4N-L	L 400	820	1260	1720	2260	2840	
	5N-L	L 340	720	1100	1580	2160	2700	
	AVE.	396	760	1168	1600	2136	2668	
	MAX.	440	820	1260	1740	2280	2840	
	MIN.	340	700	1060	1400	1940	2500	
5th Torquing	1N-L	L 380	720	1120	1600	2160	2700	3820
	2N-L	L 380	720	1140	1560	2000	2460	3860
	3N-L	L 400	740	1200	1700	2240	2760	4060
	4N-L	L 360	740	1200	1740	2340	3040	4540
	5N-L	L 340	700	1180	1640	2200	2780	4060
	AVE.	372	724	1168	1648	2188	2748	4068
	MAX.	400	740	1200	1740	2340	3040	4540
	MIN.	340	700	1120	1560	2000	2460	3820

COMMENTS:
(1) THE SECOND THRU FIFTH SPECIMONS TORQUED FROM THE HEAD IN THE DRY CONDITION WERE RUN ON SCARRED SPACER BLOCK WHICH BECAME PROGRESSIVELY MORE SCARRED AND COULD NOT BE SANDED SMOOTH. TORQUING TO 75,000 PSI MAX. DID NOT PREVENT THIS CONDITION.
(2) SPACER BLOCKS WERE SANDED AFTER EACH SPECIMEN RUN FOR THE LUBRICATED CONDITIONS AS WELL AS DRY DUE TO SCARRING.
(3) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

PAGE 1A

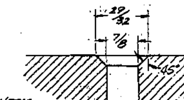
Date — 15 FEBRUARY '57
Size — J-J, 7/8-14 UNF-3A
Screw or Bolt — AN 14C-42 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
Nut — AN 310C-14 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.

Test Cell — No.
Torsion — 6B
Compression — 5C

TEST DATA

Contract No AF 33(616)2808
P-1227

Note: Figures in parenthesis denote tensile stress reached



Sketch showing head countersink in hardened steel spacing block (Rockwell C-Scale 60)

WADC TR 57-330

122

J-J

Non Lubricated — Torqued from Head

Torquing No.	Specimen No.	15,000 psi Torque (in-#)	30,000 psi Torque (in-#)	45,000 psi Torque (in-#)	60,000 psi Torque (in-#)	75,000 psi Torque (in-#)	90,000 psi Torque (in-#)	Theoretical Yield Point 111,000 Torque (in-#)
Initial Torquing	1H	2980	6860	11860	(1)			
	2H	3000	7160	11660	(1)			
	3H	3000	6720	12060	(1)			
	4H	3800	9440	15080	(1)			
	5H	4160	7840	12000	(1)			
	Ave.	3388	7604	12532				
	Max.	4160	9440	15080				
	Min.	2980	6720	11660				
2nd Torquing	1H	3900	7900	11900	(1)			
	2H	4500	8360	12860	(1)			
	3H	4700	8640	13180	(1)			
	4H	5500	10500	16000	(1)			
	5H	4700	8200	12300	(1)			
	Ave.	4660	8720	13248				
	Max.	5500	10500	16000				
	Min.	3900	7900	11900				
3rd Torquing	1H	4400	9100	14100	(1)			
	2H	4640	9340	14240	(1)			
	3H	4860	9860	15040	(1)			
	4H	6060	11740	16320	(1)			
	5H	5100	9300	14060	(1)			
	Ave.	5012	9868	14752				
	Max.	6060	11740	16320				
	Min.	4400	9100	14060				
4th Torquing	1H	5000	10020	14760	(1)			
	2H	5580	10500	16040	(1)			
	3H	5000	9860	15000	(1)			
	4H	6000	11740	17460	(1)			
	5H	5600	10500	15160	(1)			
	Ave.	5436	10514	15684				
	Max.	6000	11740	17460				
	Min.	5000	9860	14760				
5th Torquing	1H	5160	10480	15500	← Bolt broke in shear (2)			
	2H	5820	10900	18000	(48,700 PSI) 18900	Bolt broke in shear during untorquing (2)		
	3H	5900	11400	17560	Bolt broke in shear during untorquing (2)			
	4H	6340	11640	17040	"	"	" (2)	
	5H	6360	11420	16580	"	"	" (2)	
	Ave.	5916	11168	16936				
	Max.	6360	11640	18000				
	Min.	5160	10480	15500				

Non Lubricated — Torqued from Nut

Torquing No.	Specimen No.	15,000 psi Torque (in-#)	30,000 psi Torque (in-#)	45,000 psi Torque (in-#)	60,000 psi Torque (in-#)	75,000 psi Torque (in-#)	90,000 psi Torque (in-#)	Theoretical Yield Point 111,000 Torque (in-#)
Initial Torquing	1N	2580	5700	9400	(55,100 PSI) 15800 (2)	Bolt broke in shear during untorquing		
	2N	2300	5000	8400	(57,300 PSI) 14200	← 60,000 PSI point not attempted due to signs of thread seizure.		
	3N	2540	6400	11300	(48,500 PSI) 15000			
	4N	2700	6700	11800	(1)			
	5N	2740	6800	11360	(1)			
	Ave.	2572	6120	10452				
	Max.	2740	6800	11800				
	Min.	2300	5000	8400				
2nd Torquing	1N	Test discontinued						
	2N	2300	4980	8800	13200			
	3N	4720	8000	12260	(1)			
	4N	5340	9800	14940	(1)			
	5N	3740	7700	(1)				
	Ave.	4025	7620	12000	13200			
	Max.	5340	9800	14940	13200			
	Min.	2300	4980	8800	13200			
3rd Torquing	1N							
	2N	4100	7900	12280	(52,100 PSI) 15300	← 60,000 PSI pt. not attempt. due to signs of thread seizure.		
	3N	6500	10900	(37,700 PSI) 14,460 (2)	Bolt broke in shear during untorquing			
	4N	10940 (1)						
	5N	3560	7160	(1)				
	Ave.	6278	8653	12280				
	Max.	10940	10900	12280				
	Min.	3560	7160	12280				
4th Torquing	1N							
	2N	3900	7700	11500	(1)			
	3N	Test discontinued						
	4N	(9,580 PSI) 11360	← Bolt broke in shear (2)					
	5N	3900	8000	(1)				
	Ave.	3900	7850	11500				
	Max.	3900	8000	11500				
	Min.	3900	7700	11500				
5th Torquing	1N							
	2N	4000	8000	12760	(50,000 PSI) 15660	← Bolt broke in shear (2)		
	3N							
	4N	Test discontinued						
	5N	3900	7940	11700	(49,700 PSI) 15620	← Bolt broke in shear during untorquing. (2)		
	Ave.	3950	7970	12230				
	Max.	4000	8000	12760				
	Min.	3900	7940	11700				

Lubricated — Torqued from Head

Torquing No.	Specimen No.	15,000 psi Torque (in-#)	30,000 psi Torque (in-#)	45,000 psi Torque (in-#)	60,000 psi Torque (in-#)	75,000 psi Torque (in-#)	90,000 psi Torque (in-#)	Theoretical Yield Point 111,000 Torque (in-#)
Initial Torquing	1H-L	L (3) 2000	3920	5720	8000	10100	12840	
	2H-L	L 1560	2800	4160	5600	7100	12960	
	3H-L	L 1680	2980	4220	5700	6980	11160	
	4H-L	L 1700	3000	4120	5300	6620	(88,400 PSI) 13720 (4)	
	5H-L	L 2040	3600	4960	5180	8200	(83,200 PSI) 11800	
	Ave.	1796	3260	4636	5956	7800	12320	
	Max.	2040	3920	5720	8000	10100	12960	
	Min.	1560	2800	4120	5180	6620	11160	
2nd Torquing	1H-L	L 2200	3400	4300	5300	6600	8140	
	2H-L	L 1840	3200	4600	5740	6900	8540	
	3H-L	L 2020	3100	4220	5360	6740	8300	
	4H-L	L 2560	4340	5740	7100	8420	9800	
	5H-L	L 2260	3400	4420	5260	6100	7900	
	Ave.	2176	3488	4656	5752	6952	8536	
	Max.	2560	4340	5740	7100	8420	9800	
	Min.	1840	3100	4220	5260	6100	7900	
3rd Torquing	1H-L	L 1900	3140	4340	5260	6200	7660	
	2H-L	L 2000	3200	4440	5500	6020	8280	
	3H-L	L 1580	2500	3600	5120	6360	8400	
	4H-L	L 2060	3300	4200	5000	6200	7860	
	5H-L	L 2000	3180	4120	4900	5840	7800	
	Ave.	1908	3064	4140	5156	6124	8000	
	Max.	2060	3300	4440	5500	6360	8400	
	Min.	1580	2500	3600	4900	5840	7660	
4th Torquing	1H-L	L 1800	2740	3800	4700	5640	7000	
	2H-L	L 1700	2760	3720	4600	5500	7020	
	3H-L	L 1700	2740	4080	5620	6820	8700	
	4H-L	L 1700	2860	3980	5340	6520	7940	
	5H-L	L 1800	2760	3640	4600	5340	7340	
	Ave.	1740	2772	3844	4972	5964	7600	
	Max.	1800	2860	4080	5620	6820	8700	
	Min.	1700	2740	3640	4600	5340	7000	
5th Torquing	1H-L	L 1520	2560	3380	4400	5340	6660	(97,900 PSI) 9300
	2H-L	L 2500	2820	3560	4420	5360	6700	(97,300 PSI) 8800
	3H-L	L 2000	3220	4560	5900	7220	8920	(94,700 PSI) 10500
	4H-L	L 1860	3100	4260	5200	6200	8000	(96,600 PSI) 9500
	5H-L	L 1960	2960	4120	5000	5900	7740	← All bolts yielded
	Ave.	1968	3134	3976	4984	6004	7604	
	Max.	2500	3220	4560	5900	7220	8920	
	Min.	1520	2560	3380	4400	5340	6660	

Lubricated — Torqued from Nut

Torquing No.	Specimen No.	15,000 psi Torque (in-#)	30,000 psi Torque (in-#)	45,000 psi Torque (in-#)	60,000 psi Torque (in-#)	75,000 psi Torque (in-#)	90,000 psi Torque (in-#)	Theoretical Yield Point 111,000 Torque (in-#)
Initial Torquing	1N-L	L (3) 1100	2160	3160	4240	5700	8500	
	2N-L	L 1280	2240	3720	4800	5820	7300	
	3N-L	L 1240	2500	3600	4700	5860	8200	
	4N-L	L 1300	2460	3700	4400	5700	9800	
	5N-L	L 1400	2560	3480	4300	5560	8860	
	Ave.	1264	2372	3532	4488	5728	8532	
	Max.	1400	2560	3720	4800	5860	9800	
	Min.	1100	2160	3160	4240	5560	7300	
2nd Torquing	1N-L	L 1600	2720	3800	4960	5840	7160	
	2N-L	L 760	1800	2500	3300	4200	5800	
	3N-L	L 760	1660	2500	3360	4400	6060	
	4N-L	L 1100	1980	2700	3620	4860	6860	
	5N-L	L 1200	2060	2860	3860	4720	6480	
	Ave.	1084	2044	2872	3820	4812	6472	
	Max.	1600	2720	3800	4960	5840	7160	
	Min.	760	1660	2500	3300	4200	5800	
3rd Torquing	1N-L	L 1600	2620	3540	4340	5100	6120	
	2N-L	L 740	1560	2400	3200	4260	5600	
	3N-L	L 800	1500	2300	3200	4200	5740	
	4N-L	L 1100	1900	2700	3600	4460	5820	
	5N-L	L 1140	2000	2840	3780	4920	6600	
	Ave.	1076	1916	2756	3624	4588	5976	
	Max.	1600	2620	3540	4340	5100	6600	
	Min.	740	1500	2300	3200	4100	5600	
4th Torquing	1N-L	L 800	2000	2960	3980	4300	5600	
	2N-L	L 660	1440	2260	3060	3960	5300	
	3N-L	L 700	1400	2300	3200	4160	5640	
	4N-L	L 900	1580	2400	3400	4420	6000	
	5N-L	L 980	1700	2340	3200	4000	5040	
	Ave.	808	1624	2452	3368	4168	5516	
	Max.	980	2000	2960	3980	4420	6000	
	Min.	660	1400	2260	3060	3960	5040	
5th Torquing	1N-L	L 800	1800	2740	3460	4220	5720	(105,000 PSI) 8000
	2N-L	L 600	1300	2000	2600	3700	5080	(100,900 PSI) 9000
	3N-L	L 700	1400	2000	2840	3660	5000	(104,000 PSI) 9000
	4N-L	L 900	1620	2400	3340	4140	5560	(100,000 PSI) 8500
	5N-L	L 860	1500	2200	3000	3940	5240	(100,300 PSI) 8500
	Ave.	772	1524	2268	3048	3932	5320	
	Max.	900	1800	2740	3460	4220	5720	
	Min.	600	1300	2000	2600	3660	5000	

Comments:
(1) Bolts torqued under dry conditions were torqued to 45,000 PSI only to prevent failure of the bolt root area in shear due to thread seizure.
(2) Thread seizure between stainless steel nuts and bolts caused premature thread yield and bolt failure in shear during torquing & untorquing of bolts in dry conditions.
(3) Runs of lubricated torquings are marked with an "L" at the beginning of the run to indicate initial lubrication and subsequent lubrications of nut or head bearing surfaces.
(4) Specimens 4H-L & 5H-L were not torqued to 90,000 PSI for 1st torquing due to signs of approaching bolt yield at higher stress values. These values of torque were not averaged.
(5) Spacer blocks were sanded before each run for both lubricated & dry conditions due to scarring.

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WADC TR 57330

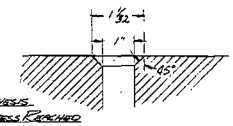
123

DATE — 19 MAR. '57
SIZE — K-K 1-14 NF-3A
SCREW OR BOLT — AN 164 C-42 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
NUT — AN 310 C16 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.

TEST CELL - No.
TORQUE -68
COMPRESSION-50

TEST DATA
CONTRACT No. AF 33(616)2808
P-1227

NOTE:
FIGURES IN PARENTHESS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL C - SCALE 60)

K-K

NON LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	TENSILE STRESS (#/in²) 15,000 TORQUE (in-#)	30,000 TORQUE (in-#)	45,000 TORQUE (in-#)	60,000 TORQUE (in-#)	75,000 TORQUE (in-#)	90,000 TORQUE (in-#)	THEORETICAL YIELD POINT 111,000 TORQUE (in-#)
INITIAL TORQUING							
1H	2260	7060	12700	(1)			
2H	2400	6800	11700	(1)			
3H	2620	7440	14040	(1)			
4H	3720	9360	15140	(1)			
5H	3000	7660	12640	(1)			
AVE.	2796	7864	13248				
MAX.	3720	9360	15140				
MIN.	2260	6800	11700				
2ND TORQUING							
1H	3800	9000	13960	(1)			
2H	3700	8640	[illegible]	(1)			
3H	4300	12400	15600	(1)			
4H	4400	10060	15500	(1)			
5H	4100	9060	14400	(1)			
AVE.	4060	9432	14652				
MAX.	4400	10400	15660				
MIN.	3700	8640	13740				
3RD TORQUING							
1H	3200	9100	14840	(1)			
2H	3940	9700	14680	(1)			
3H	4200	10440	16300	(1)			
4H	4500	10500	15760	(1)			
5H	4060	9720	14960	(1)			
AVE.	3980	9892	15304				
MAX.	4500	10500	16300				
MIN.	3200	9100	14680				
4TH TORQUING							
1H	4100	10400	[illegible]	(1)			
2H	3920	9500	[illegible]	(1)			
3H	4600	10620	[illegible]	(1)			
4H	4700	10600	15940	(1)			
5H	4300	[illegible]	15920	(1)			
AVE.	4324	10260	16136				
MAX.	4700	10680	16760				
MIN.	3920	9500	15820				
5TH TORQUING							
1H	4500	10840	16540	(1) (3)			
2H	4200	10200	[illegible]	(1) (3)			
3H	4900	11520	17[illegible]	(1) (3)			
4H	4640	10880	[illegible]	(1) (3)			
5H	4860	11000	16860	(1) (3)			
AVE.	4620	10900	16784				
MAX.	4900	11580	17320				
MIN.	4200	10200	16060				

TORQUED FROM NUT

SPECIMEN No.	TENSILE STRESS (#/in²) 15,000 TORQUE (in-#)	30,000 TORQUE (in-#)	45,000 TORQUE (in-#)	60,000 TORQUE (in-#)	75,000 TORQUE (in-#)	90,000 TORQUE (in-#)	THEORETICAL YIELD POINT 111,000 TORQUE (in-#)
1N	1400	5000	9920	15240			
2N	1800	7020	11700	(1)			
3N	2160	5720	9900	(1)			
4N	2000	5800	9000	(1)			
5N	1900	5600	9460	(1)			
AVE.	1852	5828	9996	15240			
MAX.	2160	7020	11700	15240			
MIN.	1400	5000	9000	15240			
1N	3400	8[illegible]	13140	(1)			
2N	3100	7680	11680	(1)			
3N	2880	6720	10680	(1)			
4N	3000	6800	10440	(1)			
5N	2800	6960	10600	(1)			
AVE.	3036	7352	11308				
MAX.	3460	8600	13140				
MIN.	2800	6720	10440				
1N	3500	8240	13[illegible]	(1)			
2N	3200	7400	11480	(1)			
3N	3080	7060	11200	(1)			
4N	3380	7340	11200	(1)			
5N	2820	6600	10540	(1)			
AVE.	3196	7328	11544				
MAX.	3500	8240	13300				
MIN.	2820	6600	10540				
1N	3300	8240	13060	(1)			
2N	3140	7740	12000	(1)			
3N	3420	7960	12160	(1)			
4N	3800	7760	11760	(1)			
5N	2500	6800	10120	(1)			
AVE.	3232	7700	11940				
MAX.	3800	8240	13260				
MIN.	2500	6800	10120				
1N	2800	7400	11500	7320			← BOLT FAILED IN SHEAR DURING UNTORQUING
2N	3300	7920	12200	(1)			
3N	3260	7400	12060	(1)			
4N	3560	7600	11700	(1)			
5N	2760	6760	10420	(1)			
AVE.	3136	7416	11636	17330			
MAX.	3560	7920	12200	17880			
MIN.	2760	6760	10420	17880			

LUBRICATED

TORQUED FROM HEAD

SPECIMEN No.	TENSILE STRESS (#/in²) 15,000 TORQUE (in-#)	30,000 TORQUE (in-#)	45,000 TORQUE (in-#)	60,000 TORQUE (in-#)	75,000 TORQUE (in-#)	90,000 TORQUE (in-#)	THEORETICAL YIELD POINT 111,000 TORQUE (in-#)
1H-L	(4) 1360	3300	5320	7560	9720	12080	
2H-L	1700	3640	5860	8360	11240	14420	
3H-L	1160	3100	4780	6500	8500	10460	
4H-L	1600	3320	5240	7000	9040	11540	
5H-L	1420	2500	5260	1040	9060	10620	
AVE.	1448	3172	5292	7292	9512	11824	
MAX.	1700	3640	5860	8360	11240	14420	
MIN.	1160	2500	4780	6500	8500	10460	
1H-L	1960	3540	5000	6340	7800	9500	
2H-L	2020	4000	5500	7100	8700	10120	
3H-L	2020	3520	4800	6500	7900	9200	
4H-L	1300	3000	4400	5840	7340	9060	
5H-L	1400	32[illegible]	4560	5800	7200	8560	
AVE.	1740	3468	4852	6316	7788	9288	
MAX.	2020	4000	5500	7100	8700	10120	
MIN.	1300	3000	4400	5800	7200	8560	
1H-L	1660	3100	4260	5360	6720	8500	
2H-L	1520	3400	4660	6120	7620	9300	
3H-L	1980	3120	4300	5440	6660	8100	
4H-L	1380	2840	3920	5240	6400	7620	
5H-L	1420	3360	4400	5900	7200	8760	
AVE.	1592	3164	4308	5612	6920	8456	
MAX.	1980	3400	4660	6120	7620	9300	
MIN.	1380	2840	3920	5240	6400	7620	
1H-L	1640	3320	4600	5800	6800	8200	
2H-L	1500	2980	4360	5800	7300	9000	
3H-L	1460	2820	3900	5200	6560	8160	
4H-L	1300	2400	3480	4720	5940	7300	
5H-L	1240	2920	3840	5100	5960	8040	
AVE.	1568	2884	4036	5324	6512	8140	
MAX.	1940	3320	4600	5800	7300	9000	
MIN.	1300	2400	3480	4720	5940	7300	
1H-L	1400	2600	3800	5200	6500	8160	(5) 10940
2H-L	1500	2880	4200	5860	7500	9320	(5) 12460
3H-L	1000	2300	3220	4500	5780	7400	(5) 10580
4H-L	1340	2480	3440	4600	5820	7160	(5) 10200
5H-L	1160	2400	3500	4760	6020	7700	(5) 11140
AVE.	1280	2532	3632	4984	6324	7944	11064
MAX.	1500	2880	4200	5860	7500	9320	12460
MIN.	1000	2300	3220	4500	5780	7160	10200

TORQUED FROM NUT

SPECIMEN No.	TENSILE STRESS (#/in²) 15,000 TORQUE (in-#)	30,000 TORQUE (in-#)	45,000 TORQUE (in-#)	60,000 TORQUE (in-#)	75,000 TORQUE (in-#)	90,000 TORQUE (in-#)	THEORETICAL YIELD POINT 111,000 TORQUE (in-#)
1N-L	(4) 1400	2660	4100	5400	7000	8360	
2N-L	780	2200	3380	4900	6720	8820	
3N-L	1200	2700	4000	5600	7160	8960	
4N-L	1400	2740	4000	5400	7000	9000	
5N-L	1040	2540	4120	5900	7500	9500	
AVE.	1164	2568	3920	5440	7076	9048	
MAX.	1400	2740	4120	5900	7500	9500	
MIN.	780	2200	3380	4900	6720	8820	
1N-L	1200	2300	3640	5000	6300	8100	
2N-L	820	2100	3140	4500	5720	7540	
3N-L	1400	2640	3740	5120	6700	8460	
4N-L	1080	2100	3040	4300	5640	7240	
5N-L	1000	2300	3560	5100	6780	8720	
AVE.	1100	2288	3424	4804	6228	8012	
MAX.	1400	2640	3740	5120	6780	8720	
MIN.	820	2100	3040	4300	5640	7240	
1N-L	1100	2180	3160	4360	5820	7500	
2N-L	800	2000	3200	4560	6160	7720	
3N-L	1200	2360	3400	4760	6000	7580	
4N-L	960	2000	3080	4300	5660	7200	
5N-L	1300	2660	3900	5260	6700	8800	
AVE.	1072	2240	3348	4648	6068	7760	
MAX.	1300	2660	3900	5260	6700	8800	
MIN.	800	2000	3080	4300	5660	7200	
1N-L	1020	2300	3300	4460	5600	7200	
2N-L	900	2280	3400	4800	6160	7600	
3N-L	1000	2360	3580	4900	6200	7900	
4N-L	1000	2000	3000	4080	5520	6800	
5N-L	800	2200	3300	4700	6100	7740	
AVE.	944	2228	3316	4588	5972	7448	
MAX.	1020	2360	3580	4900	6160	7900	
MIN.	800	2000	3000	4080	5500	6800	
1N-L	960	1920	2760	3800	5000	6420	10200
2N-L	800	1880	2800	4140	5600	7240	10600
3N-L	800	1980	3020	4500	5880	7820	11980
4N-L	940	2140	3000	4100	5240	6500	9300
5N-L	900	2200	3000	4800	6300	8220	11220
AVE.	880	2024	2916	4268	5604	7236	10660
MAX.	960	2200	3020	4800	6300	8220	11980
MIN.	800	1880	2760	3800	5000	6420	9300

COMMENTS:
(1) BOLTS TORQUED UNDER DRY CONDITIONS WERE TORQUED TO 45,000 PSI TO PREVENT FAILURE OF THE BOLT ROOT AREA IN SHEAR DUE TO THREAD SEIZURE.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED & DRY CONDITIONS DUE TO SCARRING.
(3) BOLTS TORQUED FROM THE HEAD IN BOTH LUBRICATED & DRY CONDITIONS SCARRED UP THE BLOCK SUCH THAT THESE BOLTS COULD NOT BE REMOVED BY SANDING. TORQUING TO 45,000 PSI ONLY IN THE DRY CONDITION DID NOT PREVENT THIS PROGRESSIVE SCARRING.
(4) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATIONS OF NUT OR HEAD BEARING SURFACES.

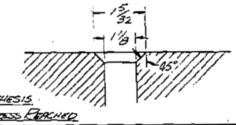
PAGE 14

DATE 25 MARCH '51
SIZE L-L, 1 1/8-12 UNF-3A
SCREW OR BOLT — AN 18C-44 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
NUT — AN 310C 18 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.

TEST CELL - NO.
TORSION - GA&GB
COMPRESSION - SD

TEST DATA
CONTRACT NO. AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL C - SCALE 60)

WADC TR 57-330

L-L — NON LUBRICATED — TORQUED FROM HEAD — TENSILE STRESS (#/in²), TORQUE (in.-#)

Torquing No.	Specimen No.	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1H	3000	8600	16000	24600 (1)			X
	2H	4000	10600	17[illegible]	25000 (1)			X
	3H	5400	12400	21600	31000 (1)			X
	4H	4400	11400	18600	[illegible]600 (1)			X
	5H	[illegible]	[illegible]	[illegible]	[illegible] (1)			X
	AVE.	4080	10600	18360	27040			
	MAX.	5400	13400	21600	31000			
	MIN.	3000	8600	16000	24600			
2nd Torquing	1H	7000	14200	[illegible]	31200 (1)			X
	2H	5900	[illegible]4000	21000	30000 (1)			X
	3H	7200	15600	24200	33400 (1)			X
	4H	[illegible]	15000	23000	32000 (1)			X
	5H	6600	14800	22800	[illegible] (1)			X
	AVE.	6720	14720	22760	31560			
	MAX.	7200	15600	24200	33460			
	MIN.	5800	14000	21000	30000			
3rd Torquing	1H	7000	[illegible]	24600	32600 (1)			X
	2H	7000	16000	[illegible]	[illegible] (1)			X
	3H	7600	16400	24600	35600 (1)			X
	4H	8000	17000	24000	33000 (1)			X
	5H	8000	16000	24200	32200 (1)			X
	AVE.	7520	16320	24280	32880			
	MAX.	8000	17000	24600	35600			
	MIN.	7000	16000	23400	31000			
4th Torquing	1H	7800	16000	27400	34800 (1)			X
	2H	7200	15900	23600	33400 (1)			X
	3H	[illegible]	[illegible]	266[illegible]	3500[illegible] ← BOLT BROKE IN SHEAR (3)			X
	4H	8400	16[illegible]	276[illegible]	[illegible] ← BOLT BROKE IN SHEAR (3)			X
	5H	8600	16[illegible]	26000	36000 (1)			X
	AVE.	7920	16240	26240	35120			
	MAX.	8600	16600	27600	36400			
	MIN.	7200	15800	23600	33400			
5th Torquing	1H	5400	13400	26000	37000 (1)(3)			
	2H	7000	[illegible]	25000	36000 (1)(3)			
	3H	TEST [illegible]						
	4H	TEST DISCONTINUED						
	5H	3000	17000	279[illegible]	(48,700 PSI) 33[illegible] BOLT BROKE IN SHEAR (NOT AVERAGED)			
	AVE.	6700	15466	26266	36,500			
	MAX.	8000	17000	27200	37000			
	MIN.	5400	13400	25000	36,000			

L-L — NON LUBRICATED — TORQUED FROM NUT — TENSILE STRESS (#/in²), TORQUE (in.-#)

Torquing No.	Specimen No.	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1N	4000	8400	14200	23400 (1)			X
	2N	3800	9000	15000	23000 (1)			X
	3N	3600	8600	16000	25800 (1)			X
	4N	3200	7400	13000	20000 (1)			X
	5N	4000	10000	17600	25000 (1)			X
	AVE.	3720	8680	15160	23440			
	MAX.	4000	10000	17600	25800			
	MIN.	3200	7400	13000	20000			
2nd Torquing	1N	7100	13000	20000	26400 (1)			X
	2N	7400	14400	21200	28800 (1)			X
	3N	8000	15200	23200	31200 (1)			X
	4N	6000	12000	18600	26400 (1)			X
	5N	7000	13400	21000	28400 (1)			X
	AVE.	7100	13600	20800	28240			
	MAX.	8000	15200	23200	31200			
	MIN.	6000	12000	18600	26400			
3rd Torquing	1N	7400	13400	20200	27800 (1)			X
	2N	7400	14000	20600	27600 (1)			X
	3N	8600	16000	23000	30000 (1)			X
	4N	6400	12800	20400	28000 (1)			X
	5N	8000	13600	22400	29000 ← BOLT BROKE IN SHEAR			X
	AVE.	7560	13960	21320	28480			
	MAX.	8600	16000	23000	30000			
	MIN.	6400	12800	20200	27600			
4th Torquing	1N	6800	12800	19400	26000 (1)			X
	2N	10000	18000	26800	32000 ← BOLT BROKE IN SHEAR			X
	3N	8000	15400	22200	28600 (1)			X
	4N	6000	12000	20000	28000 (1)			X
	5N	TEST DISCONTINUED						X
	AVE.	7700	14550	22100	28650			
	MAX.	10000	18000	26800	32000			
	MIN.	6000	12000	19400	26000			
5th Torquing	1N	8000	14600	20800	29400 BOLT BROKE IN SHEAR DURING UNTORQUING			
	2N	TEST DISCONTINUED						
	3N	8000	14800	21000	29400 ← BOLT BROKE IN SHEAR			
	4N	6200	12400	19800	26000			
	5N	TEST DISCONTINUED						
	AVE.	7400	13933	20533	28266			
	MAX.	8000	14800	21000	29400			
	MIN.	6200	12400	19800	26000			

L-L — LUBRICATED — TORQUED FROM HEAD — TENSILE STRESS (#/in²), TORQUE (in.-#)

Torquing No.	Specimen No.	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1H-L	L (4) 2400	4200	7800	11200	15000	19800	X
	2H-L	L 1800	4000	7400	[illegible]	14400	[illegible]	X
	3H-L	L 2000	4000	6000	8000	10400	13600	X
	4H-L	L 2000	4000	6800	9600	13000	17000	X
	5H-L	L 2200	5000	8200	11200	15000	19000	X
	AVE.	2080	4240	7240	10120	13560	17560	
	MAX.	2400	5000	8200	11200	15000	19800	
	MIN.	1800	4000	6000	8000	10400	13600	
2nd Torquing	1H-L	L 4000	6000	8400	11200	14000	16200	X
	2H-L	L 2600	5400	7200	9400	11200	12800	X
	3H-L	L 2800	5400	7000	8600	10200	12200	X
	4H-L	L 3200	6200	9000	11000	12700	14200	X
	5H-L	L 2800	4800	6400	8600	10400	12600	X
	AVE.	3080	5560	7600	9760	11600	13600	
	MAX.	4000	6200	9000	11200	14000	16200	
	MIN.	2600	4800	6400	8600	10200	12200	
3rd Torquing	1H-L	L 3400	5200	7000	8800	10800	13400	X
	2H-L	L 2800	5200	7400	9400	12000	14000	X
	3H-L	L 2400	5000	6800	8600	10600	13000	X
	4H-L	L 3200	5600	8000	9800	11600	13600	X
	5H-L	L 2600	4600	6400	7400	10000	12000	X
	AVE.	2880	5120	7120	8800	11000	13200	
	MAX.	3400	5600	8000	9800	12000	14000	
	MIN.	2400	4600	6400	7400	10000	12000	
4th Torquing	1H-L	L 2800	5200	7200	9000	10400	12400	X
	2H-L	L 2800	5200	7200	9400	11000	13600	X
	3H-L	L 2400	4400	6400	8400	10000	12800	X
	4H-L	L 2400	4600	7200	9000	11000	13400	X
	5H-L	L 2400	4200	6000	7600	9000	11000	X
	AVE.	2560	4720	6800	8680	10280	12640	
	MAX.	2800	5200	7200	9400	11000	13600	
	MIN.	2400	4200	6000	7600	9000	11000	
5th Torquing	1H-L	L 2800	5000	7000	8800	10000	12200	16000
	2H-L	L 2400	4800	7400	9100	11200	14200	20400
	3H-L	L 2600	4600	6200	8200	10400	12600	18400
	4H-L	L 2400	4400	6800	9800	11800	15000	20000
	5H-L	L 2800	4800	6800	8600	10400	12200	16400
	AVE.	2600	4720	6840	8900	10760	13240	18240
	MAX.	2800	5000	7400	9800	11800	15000	20400
	MIN.	2400	4400	6200	8200	10000	12200	16000

L-L — LUBRICATED — TORQUED FROM NUT — TENSILE STRESS (#/in²), TORQUE (in.-#)

Torquing No.	Specimen No.	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1N-L	L (4) 1600	3800	7200	8600	11600	15400	X
	2N-L	L 1600	3600	5200	7000	8400	13000	X
	3N-L	L 2400	4800	7000	9400	13000	20400	X
	4N-L	L 2000	3400	5600	8000	12800	16400	X
	5N-L	L 1600	3400	5000	6800	9600	12400	X
	AVE.	1840	3800	6000	7960	10960	15520	
	MAX.	2400	4800	7200	9400	13000	20400	
	MIN.	1600	3400	5000	6800	8400	12400	
2nd Torquing	1N-L	L 1800	3600	5000	6200	8800	12000	X
	2N-L	L 1800	3400	5000	6200	8000	11000	X
	3N-L	L 2200	3800	5400	8000	10000	12600	X
	4N-L	L 2000	3600	5200	7000	8400	11400	X
	5N-L	L 1800	3800	5200	6600	8200	10400	X
	AVE.	1920	3640	5160	6800	8680	11480	
	MAX.	2200	3800	5400	8000	10000	12600	
	MIN.	1800	3400	5000	6200	8000	10400	
3rd Torquing	1N-L	L 1800	3400	4800	6000	8000	10600	X
	2N-L	L 1600	3000	5200	7400	8000	11000	X
	3N-L	L 2000	3800	5600	6600	8600	11600	X
	4N-L	L 2200	3400	5800	7200	9000	12200	X
	5N-L	L 1600	3400	4600	6200	7600	10000	X
	AVE.	1840	3400	5200	6680	8240	11080	
	MAX.	2200	3800	5800	7400	9000	12200	
	MIN.	1600	3000	4600	6000	7600	10000	
4th Torquing	1N-L	L 1600	3000	4600	6200	8000	10600	X
	2N-L	L 1800	3200	4600	6200	7800	10200	X
	3N-L	L 1600	3200	4800	6000	8000	10600	X
	4N-L	L 1600	3200	4800	6600	8200	11000	X
	5N-L	L 1400	2600	4200	5800	7200	9200	X
	AVE.	1600	3040	4600	6160	7840	10320	
	MAX.	1800	3200	4800	6600	8200	11000	
	MIN.	1400	2600	4200	5800	7200	9200	
5th Torquing	1N-L	L 1600	3000	4600	6600	8000	10600	17800
	2N-L	L 1400	2600	4200	5800	7400	10000	16000
	3N-L	L 1600	3000	4800	6000	8000	10800	20000
	4N-L	L 1800	3400	5200	7000	8600	11000	18600
	5N-L	L 1600	2800	4200	5800	7200	9400	15000
	AVE.	1600	2960	4600	6240	7840	10360	17480
	MAX.	1800	3400	5200	7000	8600	11000	20000
	MIN.	1400	2600	4200	5800	7200	9400	15000

COMMENTS:
(1) BOLTS TORQUED UNDER DRY CONDITIONS WERE TORQUED TO 60,000 PSI ONLY, TO PREVENT-FAILURE OF THE BOLT ROOT AREA IN SHEAR DUE TO THREAD SEIZURE.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(3) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION SCARRED UP THE BLOCK SUCH THAT THESE SCARS COULD NOT BE REMOVED BY SANDING.
(4) RUNS OF LUBRICATED TORQUINGS ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION & SUBSEQUENT LUBRICATION OF NUT OR HEAD BEARING SURFACES.

PAGE 1A

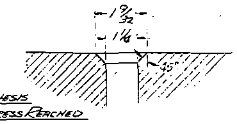
DATE ———— 8 APRIL 57
SIZE ———— M-M, 1¼-12 UNF-3A
SCREW OR BOLT — AN 20C-45 MFD. BY AERO BOLT & SCREW CO., STAMFORD, CONN.
NUT ———— AN 310C20 MFD. BY FLEXLOC DIV. OF STD. PRESSED STEEL CO., JENKINTOWN, PA.

TEST CELL — Nº
TORSION — 6A
COMPRESSION — 5D

TEST DATA

CONTRACT Nº AF 33(616)2808
P-1227

NOTE: FIGURES IN PARENTHESIS DENOTE TENSILE STRESS REACHED



SKETCH SHOWING HEAD COUNTERSINK IN HARDENED STEEL SPACING BLOCK (ROCKWELL "C" - SCALE 60)

M-M — NON LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); values are Torque (in.-#)

Torquing Nº	Specimen Nº	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1H	7000	17000	28000	40000	(1)		
	2H	7600	18800	29000	40000	(1)		
	3H	7000	18200	28600	41200	(1)		
	4H	7800	17400	27000	36400	(1)		
	5H	6400	15400	24800	35800	(1)		
	AVE.	7160	17360	27480	38640			
	MAX.	7800	18800	29000	41200			
	MIN.	6400	15400	24800	35800			
2nd Torquing	1H	8600	19000	29000	38400	(1)		
	2H	10000	21000	31000	40800	(1)		
	3H	10400	21000	30600	41800	(1)		
	4H	9600	19600	28600	37000	(1)		
	5H	9400	19400	29000	39000	(1)		
	AVE.	9600	20000	29640	39600			
	MAX.	10400	21000	31000	41800			
	MIN.	8600	19000	28600	37000			
3rd Torquing	1H	9200	19600	28000	39000	(1)		
	2H	10200	23000	33000	47000	(1)		
	3H	11000	22600	33800	44000	(1)		
	4H	10600	20600	29200	41000	(1)		
	5H	9000	19600	28600	38000	(1)		
	AVE.	10000	21080	30520	41800			
	MAX.	11000	23000	33800	47000			
	MIN.	9000	19600	28000	38000			
4th Torquing	1H	9800	20400	30000	47800	(1)		
	2H	10200	23000	37400	51800	(1)		
	3H	11000	23400	34000	49400	(1)		
	4H	10200	19800	27400	44200	(1)		
	5H	9600	20600	30400	47000	(1)		
	AVE.	10160	21440	31840	48040			
	MAX.	11000	23400	37400	51800			
	MIN.	9600	19800	27400	44200			
5th Torquing	1H	11200	21400	31400	49600	(67,900 PSI) 564[illegible] ← BOLT BROKE IN SHEAR (3)		
	2H	12000	24000	38600	52000 ← BOLT BROKE IN SHEAR (3)			
	3H	12000	24000	37000	53000	(62,800 PSI) 54,600 ← BOLT BROKE IN SHEAR (3)		
	4H	10600	21000	32000	45600	(64,600 PSI) 53000 ← BOLT BROKE IN SHEAR (3)		
	5H	10400	22200	35000	52200	(66,000 PSI) 55000 ← BOLT BROKE IN SHEAR		
	AVE.	11240	22520	34800	50480			
	MAX.	12000	24000	38600	53000			
	MIN.	10400	21000	31400	45600			

M-M — NON LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); values are Torque (in.-#)

Torquing Nº	Specimen Nº	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1N	5000	10600	19400	26800	(1)		
	2N	6000	14400	23000	33000	(1)		
	3N	9200	18200	26800	35000	(1)		
	4N	6400	14400	23600	33600	(1)		
	5N	5600	15800	24600	33600	(1)		
	AVE.	6440	14680	23480	32400			
	MAX.	9200	18200	26800	35000			
	MIN.	5000	10600	19400	26800			
2nd Torquing	1N	6800	15400	23000	33000	(1)		
	2N	8000	17600	25400	33000	(1)		
	3N	9400	18600	27600	37000	(1)		
	4N	7400	16400	24400	32200	(1)		
	5N	7600	15800	23000	31400	(1)		
	AVE.	7840	16760	24680	33320			
	MAX.	9400	18600	27600	37000			
	MIN.	6800	15400	23000	31400			
3rd Torquing	1N	6600	15000	22400	29800	(1)		
	2N	9400	17200	24000	31800	(1)		
	3N	10000	20000	28000	38200	(1)		
	4N	8000	16000	24200	30600	(1)		
	5N	8200	16000	23200	29800	(1)		
	AVE.	8440	16840	24360	32040			
	MAX.	10000	20000	28000	38200			
	MIN.	6600	15000	22400	29800			
4th Torquing	1N	7000	15000	22000	29000	(1)		
	2N	9000	17000	25400	31800	(1)		
	3N	9000	17600	26000	35400	(1)		
	4N	8200	16600	24400	31400	(1)		
	5N	7200	14600	21000	28200	(1)		
	AVE.	8080	16160	23760	31160			
	MAX.	9000	17600	26000	35400			
	MIN.	7000	14600	21000	28200			
5th Torquing	1N	7000	15000	22200	29600	36400	NO HIGHER STRESS VALUES ATTEMPTED	
	2N	9000	17600	25800	33400	41000	" "	
	3N	8400	17600	25200	34200	(60,500 PSI) 43400 ← BOLT BROKE IN SHEAR		
	4N	8000	16000	24200	33600	(73,300 PSI) 45600 ← BOLT BROKE IN SHEAR		
	5N	8000	15000	22000	33600	41000	NO HIGHER STRESS VALUES ATTEMPTED	
	AVE.	8080	16240	23880	32880			
	MAX.	9000	17600	25800	34200			
	MIN.	7000	15000	22000	29600			

M-M — LUBRICATED — TORQUED FROM HEAD

Tensile Stress (#/in²); values are Torque (in.-#)

Torquing Nº	Specimen Nº	15,000	30,000	45,000	60,000	75,000	90,000 ●	Theoretical Yield Point 111,000
Initial Torquing	1H-L	L (4) 3400	9000	14600	19600	24200	29600	
	2H-L	L 2600	4800	7800	11000	15000	22200	
	3H-L	L 4000	9000	14000	19000	23000	27400	
	4H-L	L 1400	4400	7200	10600	14600	19000	
	5H-L	L 2000	4600	7800	11200	14600	20600	
	AVE.	2680	6360	10280	14280	18280	23760	
	MAX.	4000	9000	14600	19600	24200	29600	
	MIN.	1400	4400	7200	10600	14600	19000	
2nd Torquing	1H-L	L 3200	7600	10800	13600	16400	20000	
	2H-L	L 3200	6600	9400	12200	15200	19000	
	3H-L	L 4000	7600	10400	13000	16400	19600	
	4H-L	L 2400	6400	9200	12000	14600	18000	
	5H-L	L 3200	6000	8600	11400	14200	17800	
	AVE.	3200	6720	9680	12440	15360	18880	
	MAX.	4000	7600	10800	13600	16400	20000	
	MIN.	2400	6000	8600	11400	14200	17800	
3rd Torquing	1H-L	L 3600	6400	8800	11400	14000	17400	
	2H-L	L 3400	6600	9200	11600	14800	19000	
	3H-L	L 3200	6000	8000	10000	12200	15200	
	4H-L	L 2400	5400	8400	11200	14000	16800	
	5H-L	L 2800	5600	8400	10600	13000	16200	
	AVE.	3080	6000	8560	10960	13600	16920	
	MAX.	3600	6600	9200	11600	14800	19000	
	MIN.	2400	5400	8000	10000	12200	15200	
4th Torquing	1H-L	L 2600	5800	8800	11000	13000	16600	
	2H-L	L 3000	6020	9000	11600	14400	18400	
	3H-L	L 2000	5200	7600	9600	11800	15000	
	4H-L	L 3000	5800	8400	11400	13800	17000	
	5H-L	L 3000	5600	8000	10600	13200	16200	
	AVE.	2720	5684	8360	10840	13240	16640	
	MAX.	3000	6020	9000	11600	14400	18400	
	MIN.	2000	5200	7600	9600	11800	15000	
5th Torquing	1H-L	L 2800	6000	8600	11200	13200	16000	20000
	2H-L	L 4200	6400	9400	11800	14200	18000	25000
	3H-L	L 2800	5600	7600	10000	12600	15600	21400
	4H-L	L 3000	5800	8800	11600	14000	17000	23000
	5H-L	L 3000	5400	7600	10000	12600	15600	21000
	AVE.	3160	5840	8400	10920	13320	16440	22080
	MAX.	4200	6400	9400	11800	14200	18000	25000
	MIN.	2800	5400	7600	10000	12600	15600	20000

M-M — LUBRICATED — TORQUED FROM NUT

Tensile Stress (#/in²); values are Torque (in.-#)

Torquing Nº	Specimen Nº	15,000	30,000	45,000	60,000	75,000	90,000	Theoretical Yield Point 111,000
Initial Torquing	1N-L	L (4) 2000	4600	7400	10600	14200	18600	
	2N-L	L 2000	4400	7200	10000	13600	18000	
	3N-L	L 3000	5600	8400	11600	15600	19600	
	4N-L	L 1800	4000	6600	9000	12000	16000	
	5N-L	L 1800	4000	6200	9000	12200	16600	
	AVE.	2120	4520	7160	10040	13520	17760	
	MAX.	3000	5600	8400	11600	15600	19600	
	MIN.	1800	4000	6200	9000	12000	16000	
2nd Torquing	1N-L	L 1800	3800	6000	7400	11400	15000	
	2N-L	L 2400	5000	7400	10200	13600	17600	
	3N-L	L 2600	5000	7200	10000	12800	16600	
	4N-L	L 1800	3600	5200	8600	11400	15000	
	5N-L	L 2000	4200	6400	8800	11600	15000	
	AVE.	2120	4320	6440	9000	12160	15840	
	MAX.	2600	5000	7400	10200	13600	17600	
	MIN.	1800	3600	5200	7400	11400	15000	
3rd Torquing	1N-L	L 1800	3600	6000	8200	10800	14000	
	2N-L	L 2400	4800	7200	9800	12600	16600	
	3N-L	L 2200	5000	7000	9200	12000	16000	
	4N-L	L 1800	3600	6000	8000	11000	14400	
	5N-L	L 1800	3600	5800	7800	10000	13200	
	AVE.	2000	4120	6400	8600	11280	14840	
	MAX.	2400	5000	7200	9800	12600	16600	
	MIN.	1800	3600	5800	7800	10000	13200	
4th Torquing	1N-L	L 2200	3800	6000	7800	10400	13600	
	2N-L	L 2600	4600	7000	9000	12000	15600	
	3N-L	L 2600	4400	6600	8600	11000	14600	
	4N-L	L 1800	3600	5600	7600	10000	13600	
	5N-L	L 1800	3600	5600	7600	10000	13400	
	AVE.	2200	4000	6160	8120	10680	14160	
	MAX.	2600	4600	7000	9000	12000	15600	
	MIN.	1800	3600	5600	7600	10000	13600	
5th Torquing	1N-L	L 1600	3800	5400	7200	9400	12800	19800
	2N-L	L 2200	4200	6400	8600	11200	14800	23000
	3N-L	L 2200	4000	6400	8400	10800	14400	22600
	4N-L	L 1600	3400	5600	7600	10000	13000	19600
	5N-L	L 1800	3600	5600	8000	10400	13400	19800
	AVE.	1880	3800	5880	7960	10360	13680	20960
	MAX.	2200	4200	6400	8600	11200	14[illegible]00	23000
	MIN.	1600	3400	5600	7200	9400	12800	19600

COMMENTS:
(1) BOLTS TORQUED UNDER DRY CONDITIONS WERE TORQUED TO 60,000 PSI TO PREVENT FAILURE OF THE BOLT ROOT AREA IN SHEAR DUE TO THREAD SEIZURE.
(2) SPACER BLOCKS WERE SANDED BEFORE EACH RUN FOR BOTH LUBRICATED AND DRY CONDITIONS DUE TO SCARRING.
(3) BOLTS TORQUED FROM THE HEAD IN THE DRY CONDITION SCARRED UP THE BLOCK SUCH THAT THESE SCARS COULD NOT BE REMOVED BY SANDING.
(4) RUNS OF LUBRICATED TORQUING ARE MARKED WITH AN "L" AT THE BEGINNING OF THE RUN TO INDICATE INITIAL LUBRICATION AND SUBSEQUENT LUBRICATION OF NUT OR HEAD BEARING SURFACES.

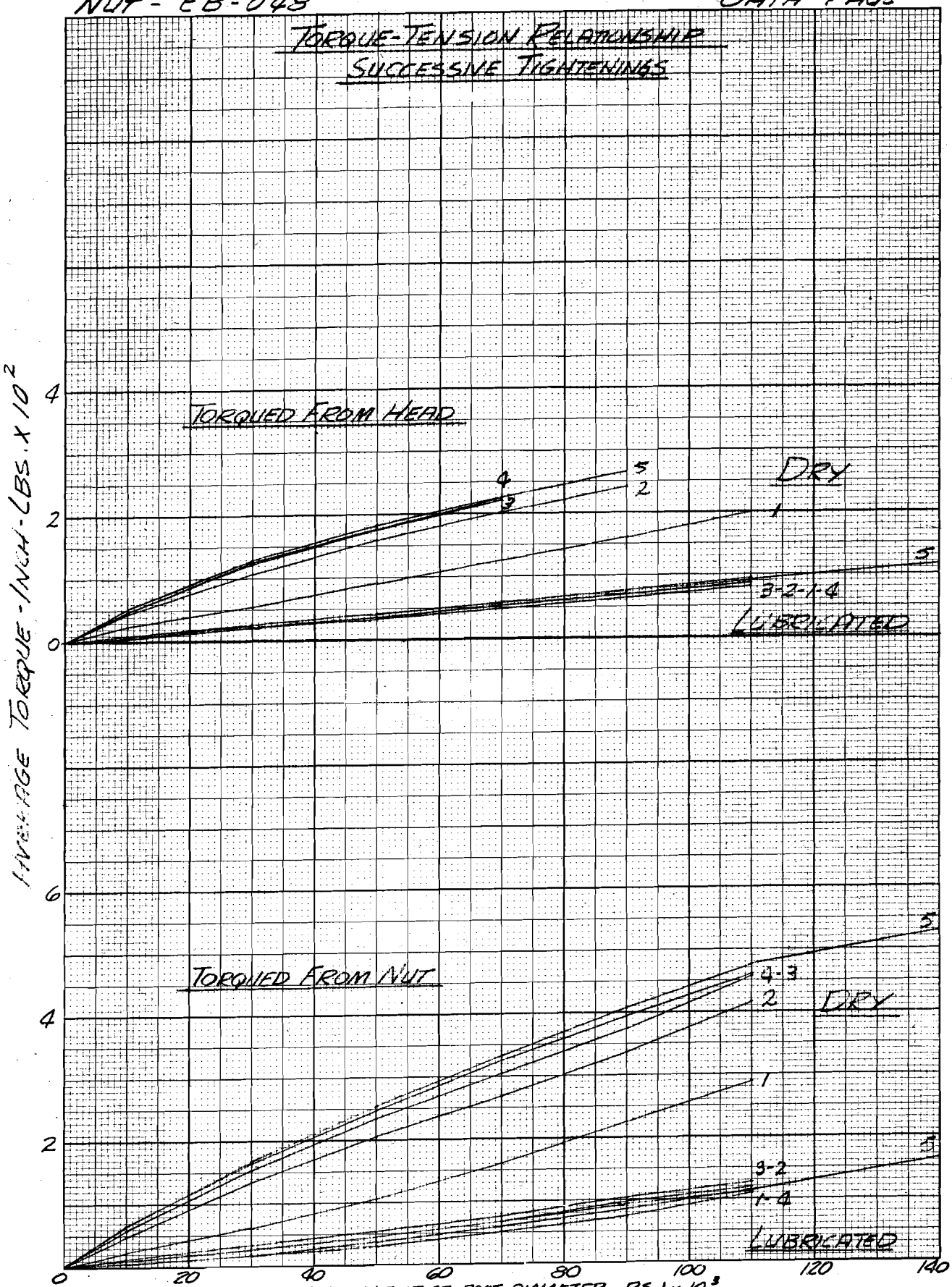
PAGE 6A

APPENDIX IV

GRAPHS
of
TORQUE TENSION RELATIONSHIPS

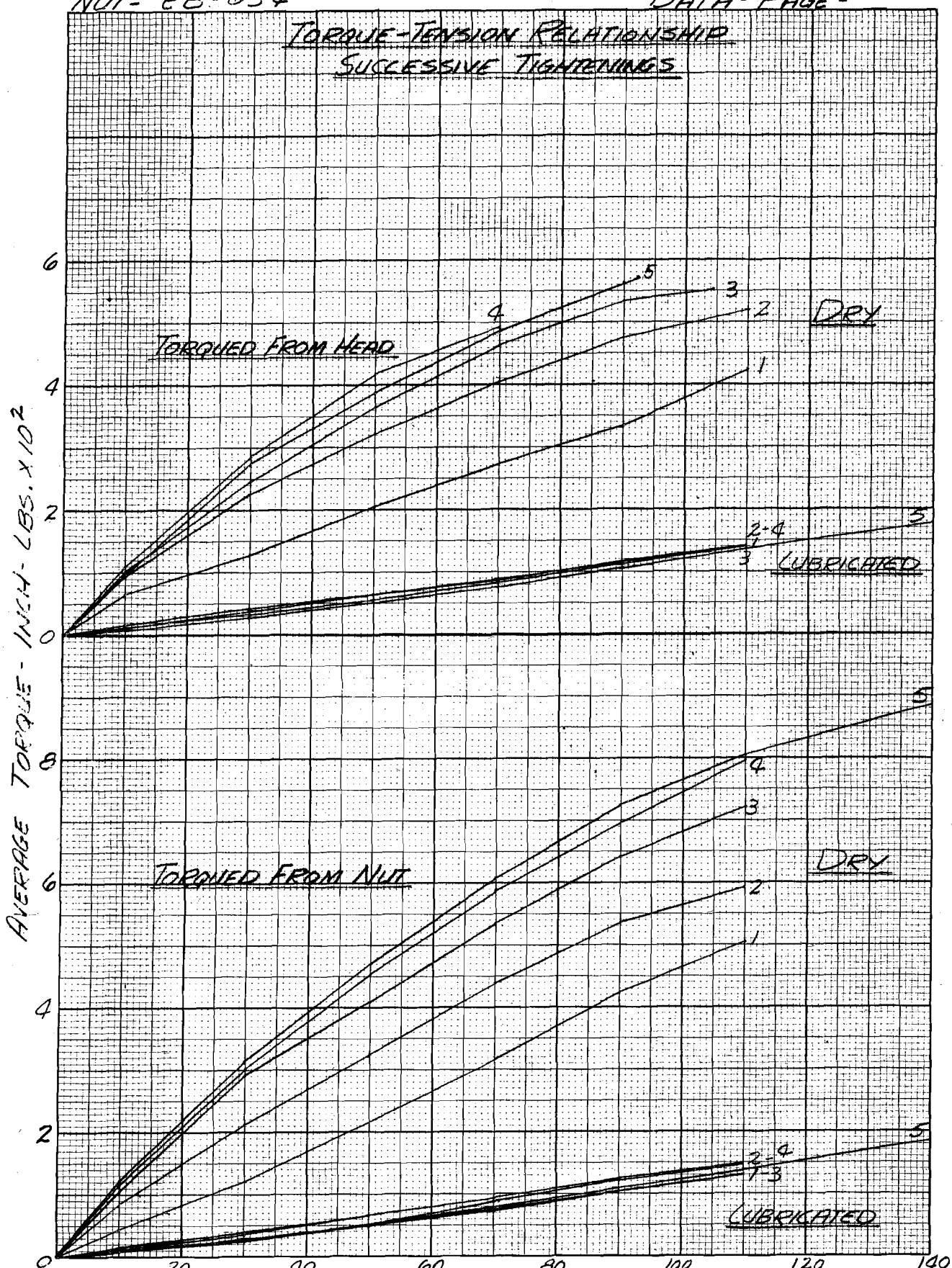
BOLT - MS 20004-42, 1/4-28 UNF-3A "A" DATE - 4-17-56

NUT - EB-048 DATA - PAGE



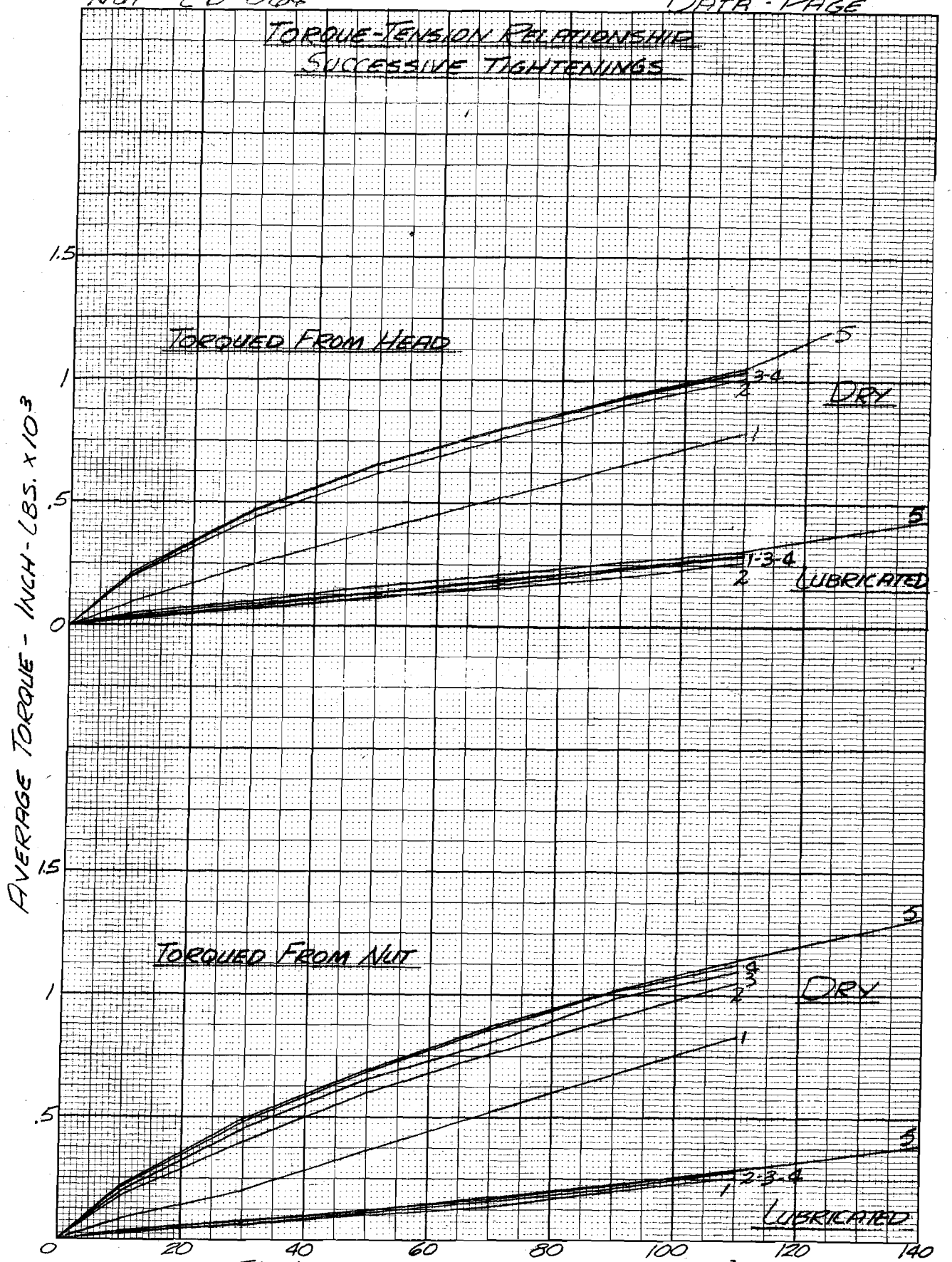
BOLT - MS 20005-50, 5/16-24 UNF-3A "B" DATE - 4-10-56

NUT - EB-054 DATA - PAGE -

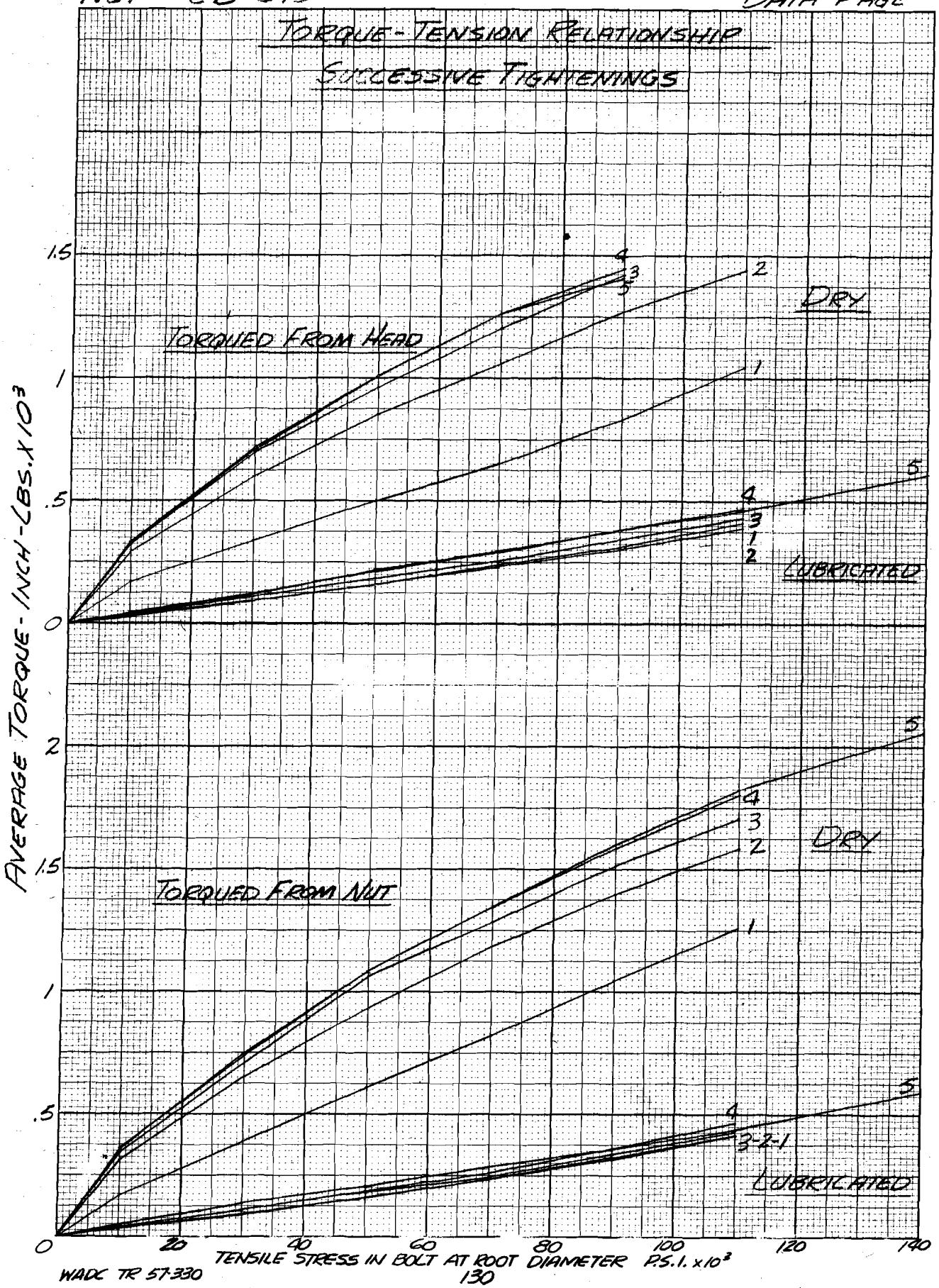


BOLT - MS 20006-50, 3/8-24 UNF-3A "C" DATE - 2-5-56

NUT - EB-064 DATA - PAGE

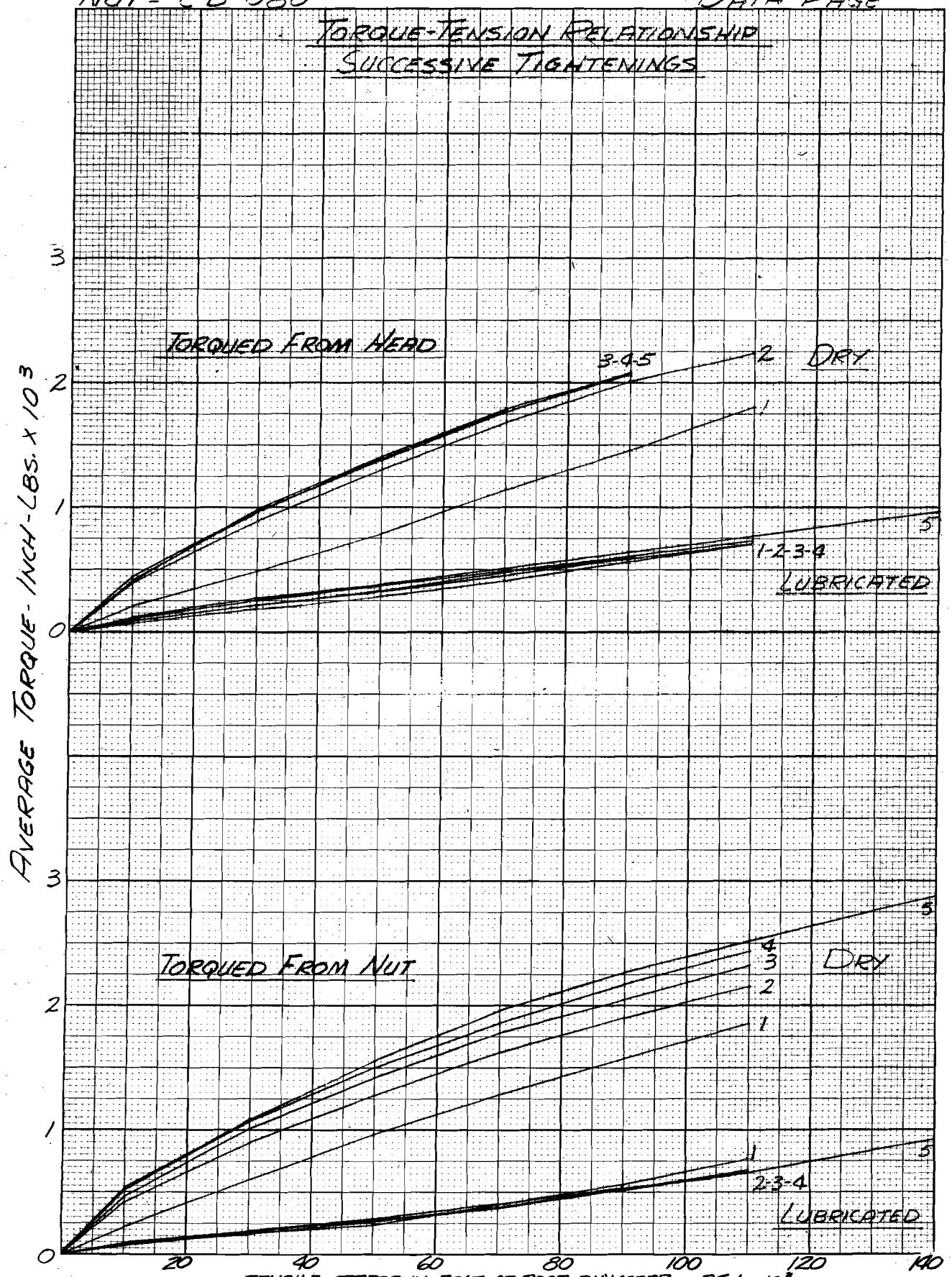


BOLT - MS 20007-50, 7/16-20UNF-3A "D" DATE-4-3-56
NUT - EB-070 DATA PAGE

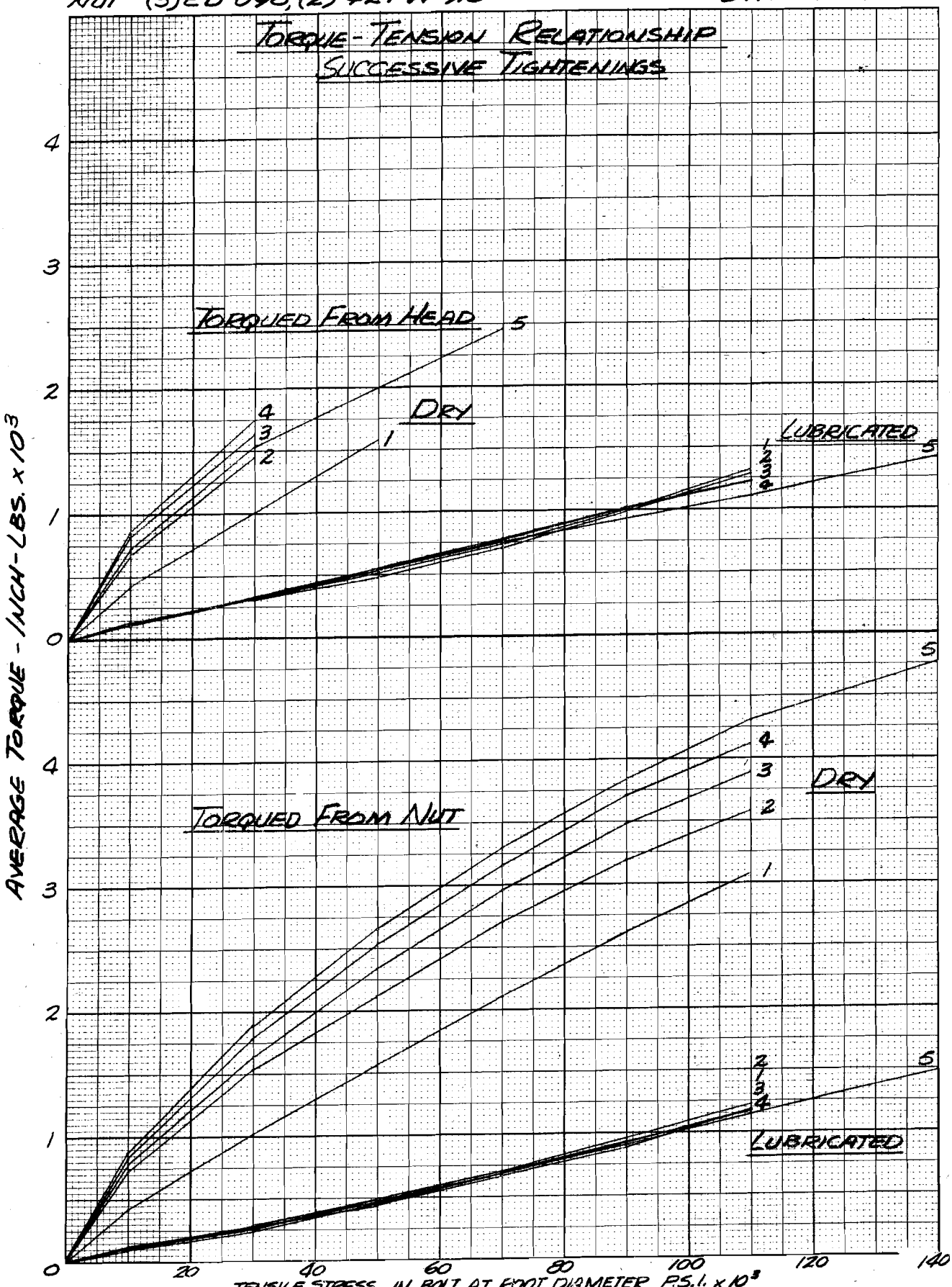


WADC TR 57-330

BOLT- MS 20008-50, 1/2-20UNF-3A "E" DATE-3-30-56
NUT- EB-080 DATA PAGE

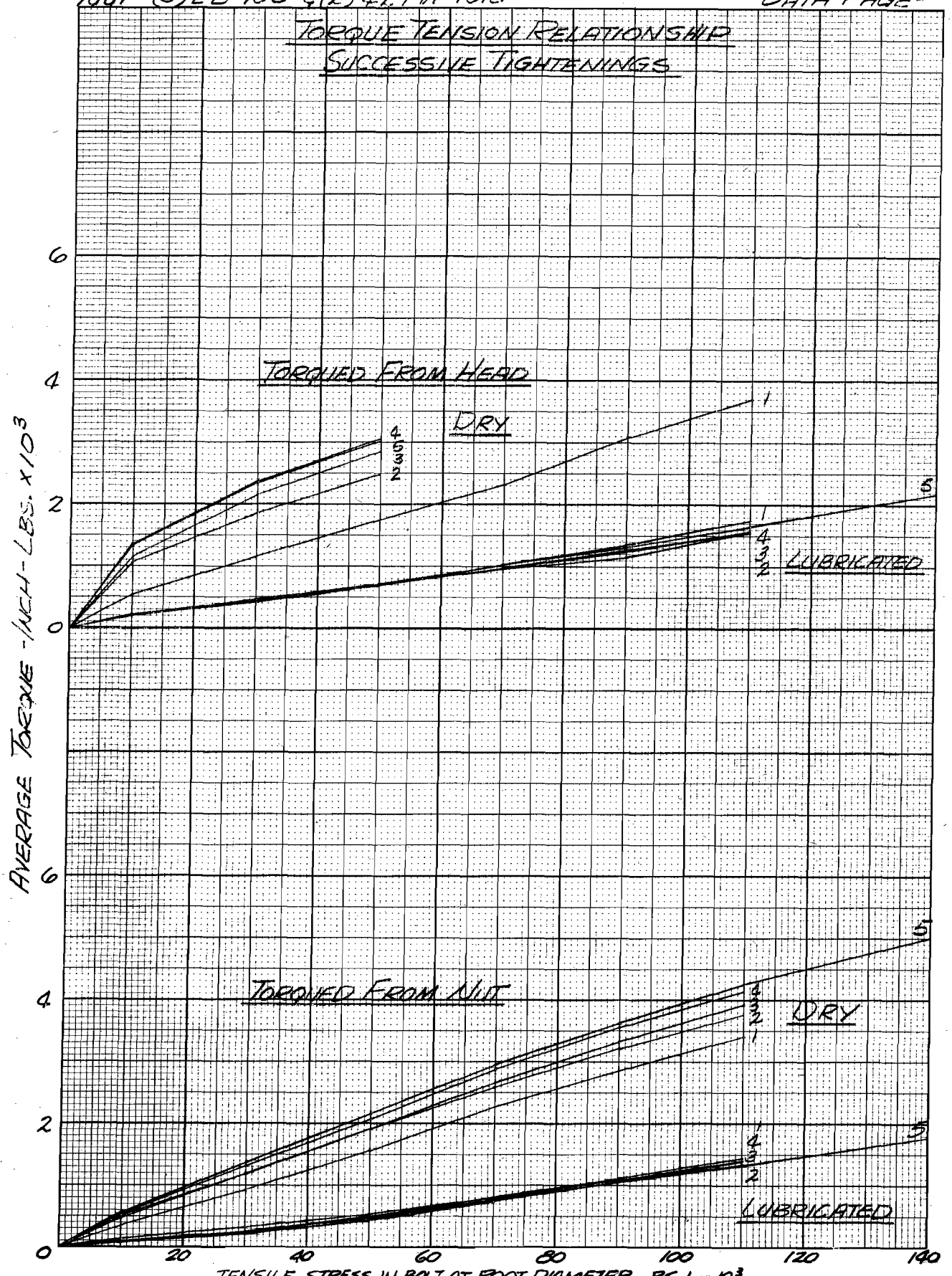


BOLT - MS 20009-50, 9/16-18 UNF-3A "F" DATE - 2-27-57
NUT - (3) EB-098, (2) 42FW-918 DATA PAGE -

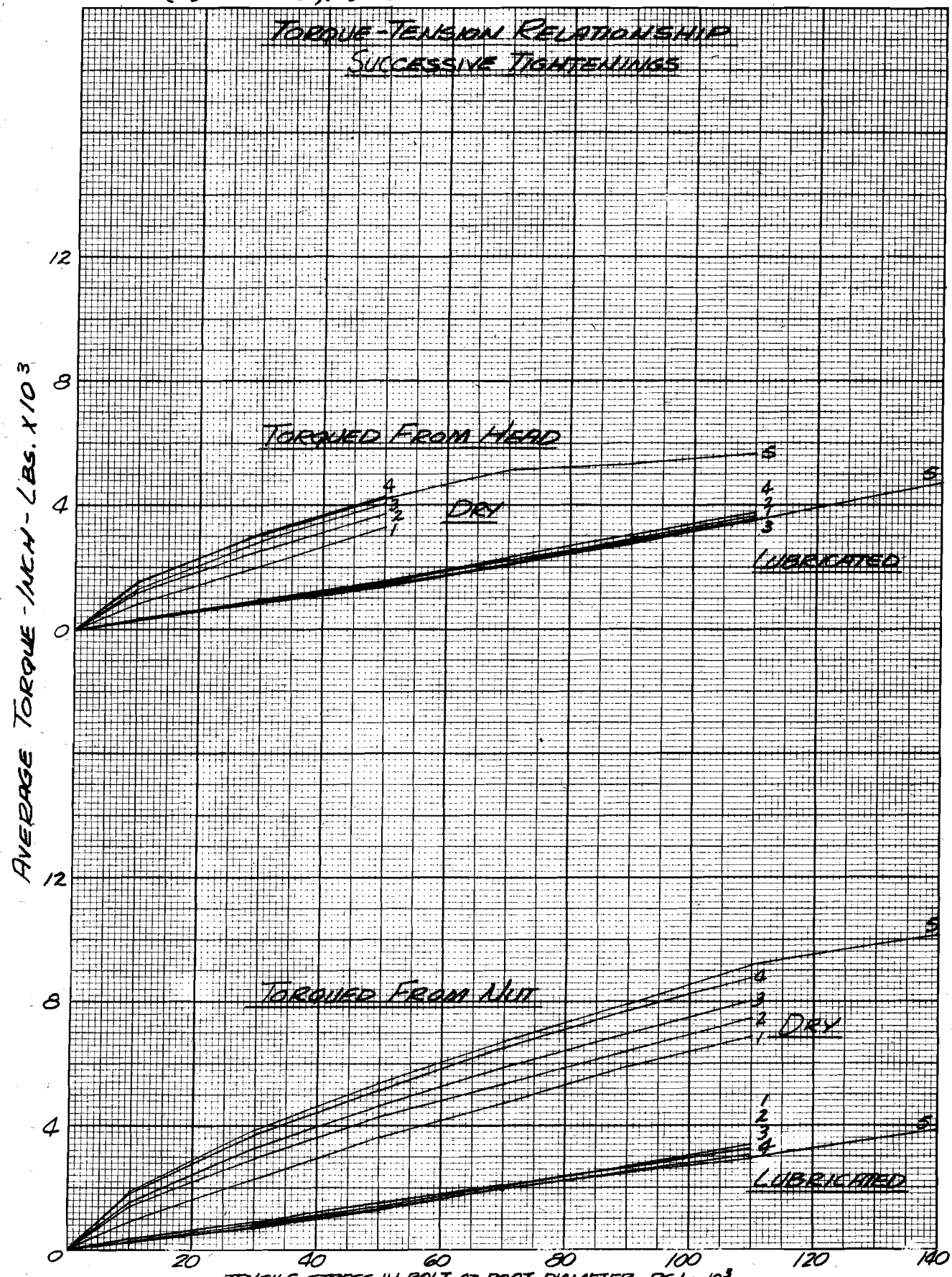


BOLT - MS-20010-50, 5/8-18 UNF-3A "G" DATE - 2-5-57

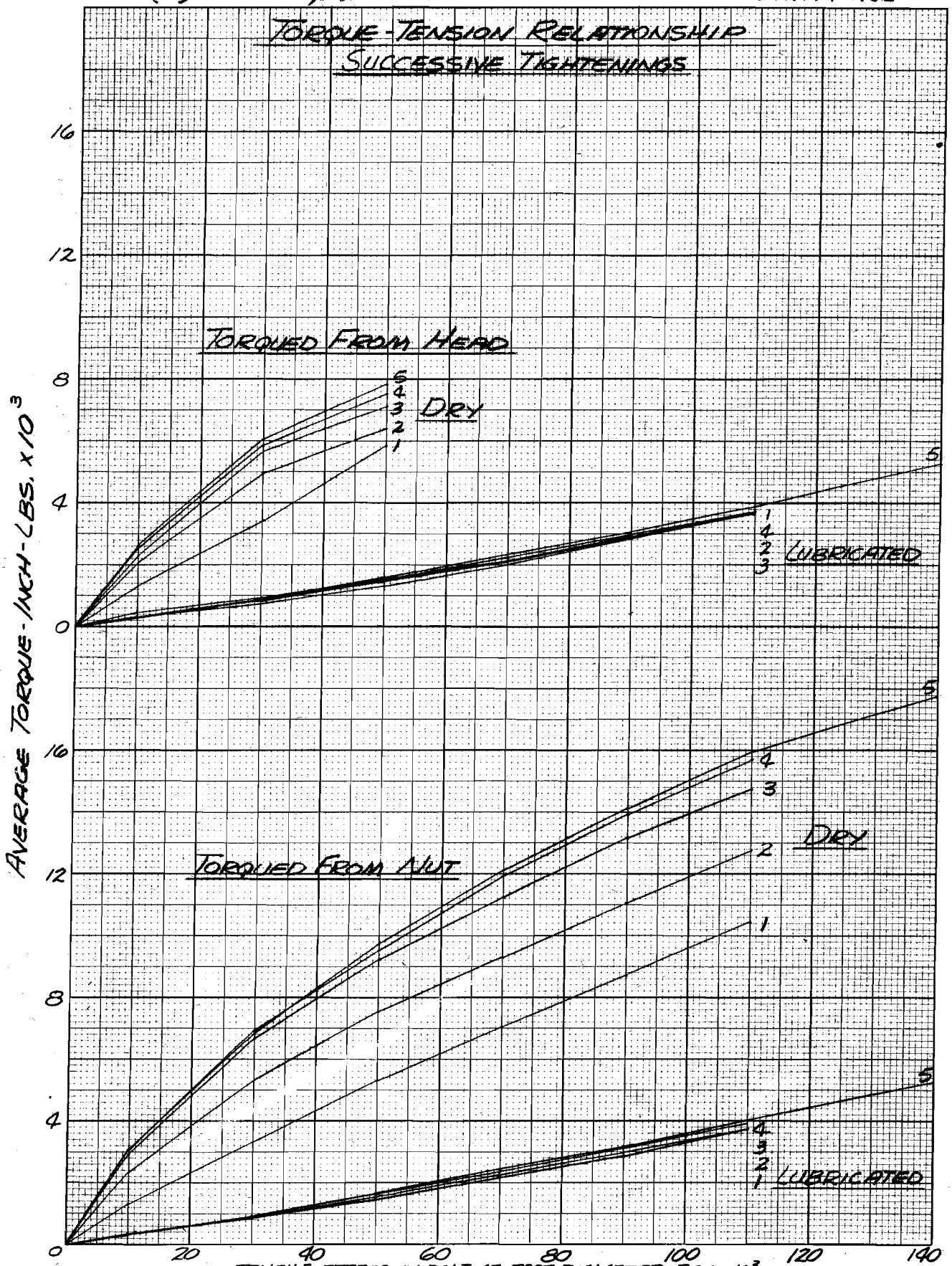
NUT - (3) EB-108 & (2) 42 FIN-1018 DATA PAGE -



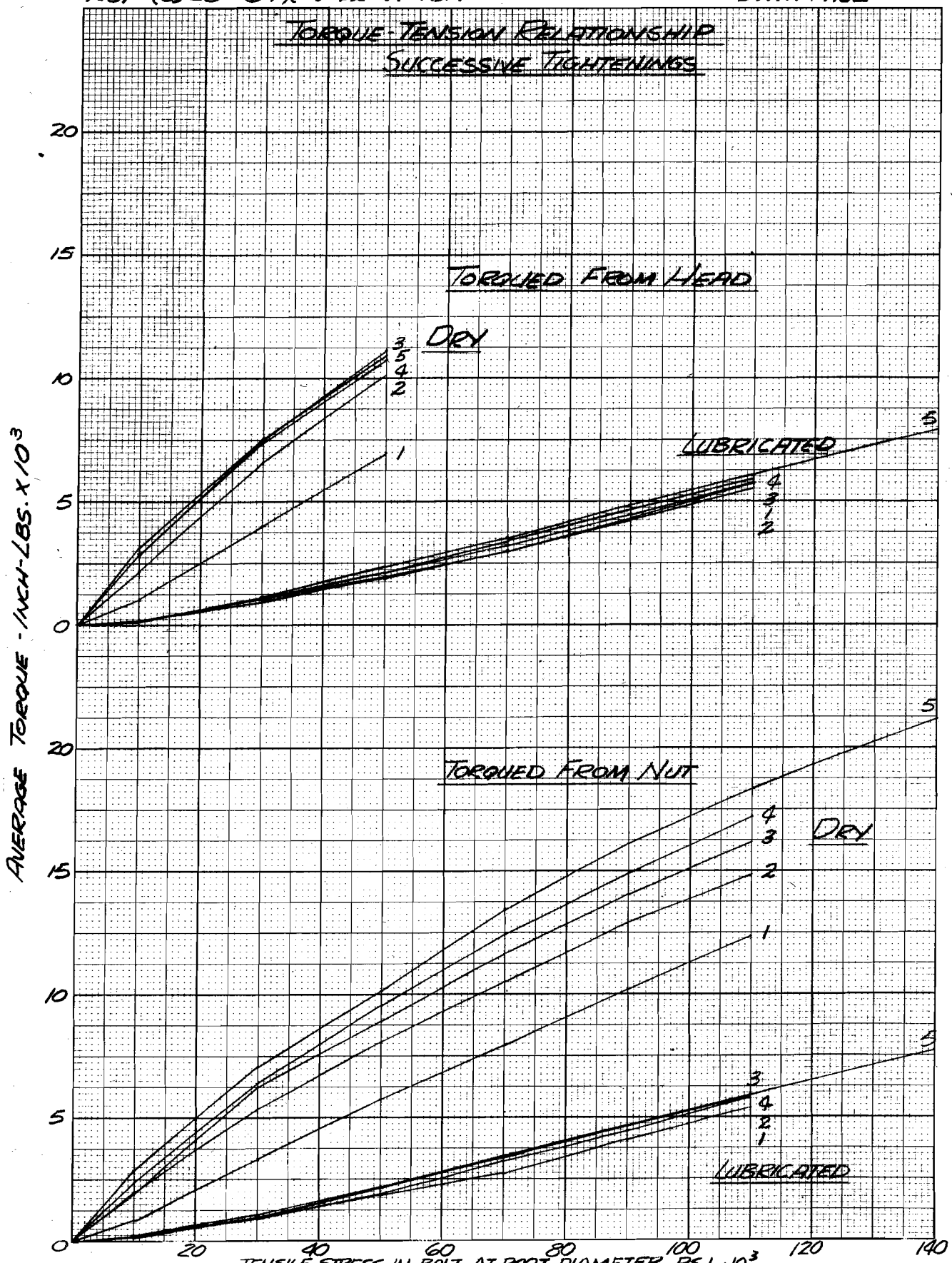
BOLT - MS 20012-50, 3/4-16 UNF-3A "H" DATE - 2-19-57
NUT - (3) EB-126, (2) 42 FW-1216 DATA PAGE



BOLT - MS 20014-50, 7/8 - 14 UNF-3A "I" DATE - 2-25-57
NUT - (3) EB-144, (2) 42 FW-1414 DATA PAGE -

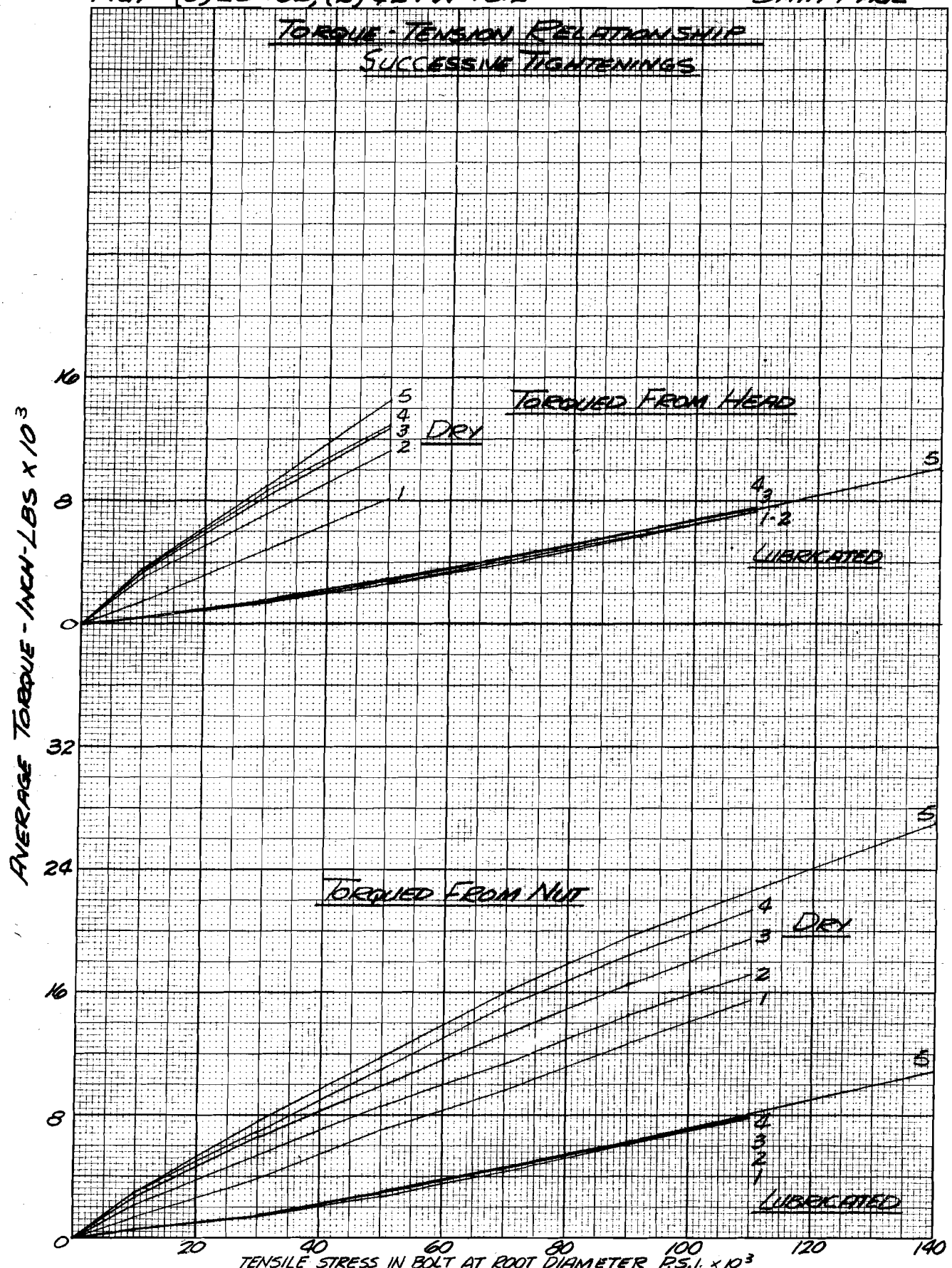


BOLT - MS 20016-50, 1-14 UNF-3A "J" DATE - 3-18-57
NUT - (3) EB-164, (2) 42FW-16M DATA PAGE -

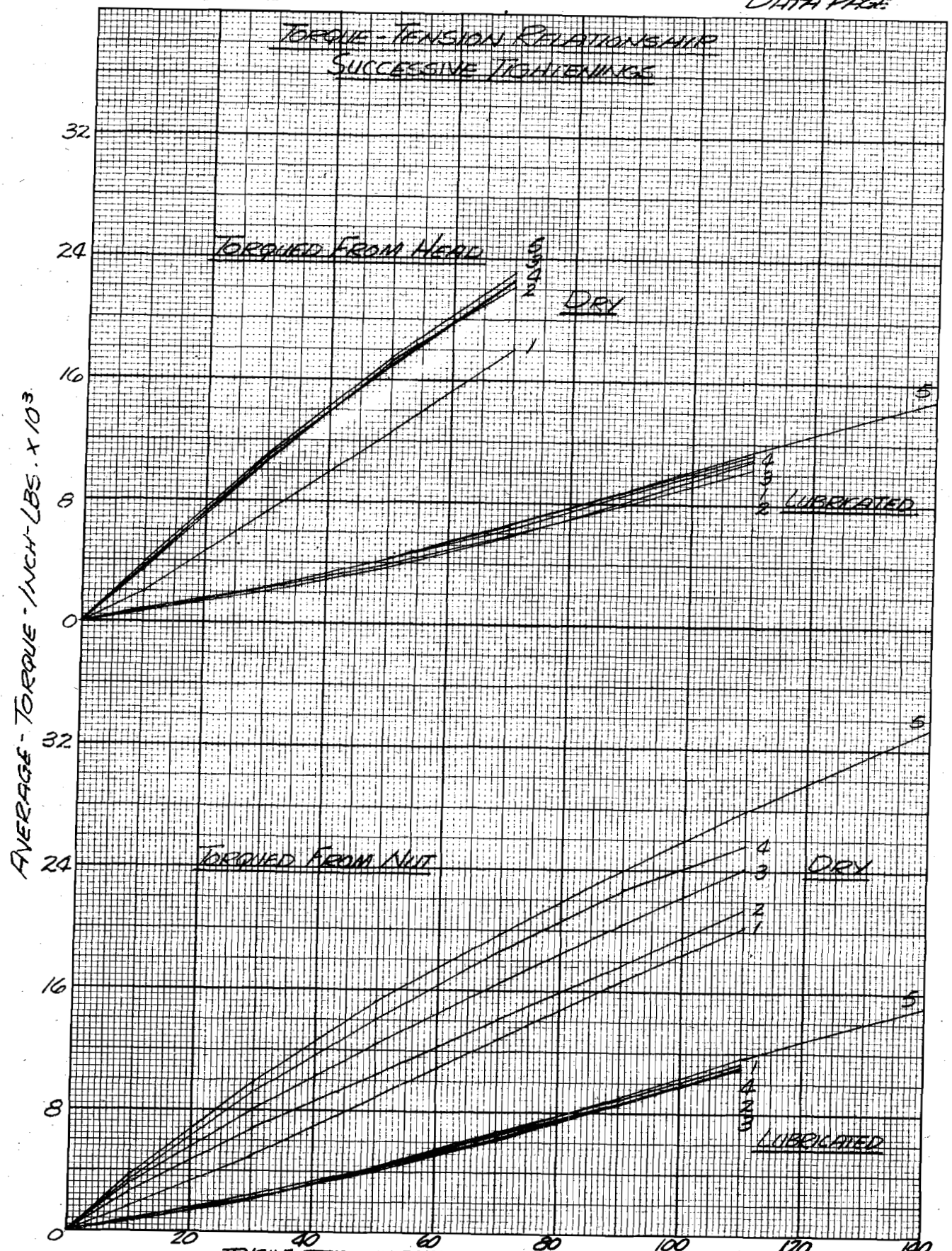


BOLT - MS 20018-50, 1 1/8-12 UNF-3A "K" DATE - 3-25-57

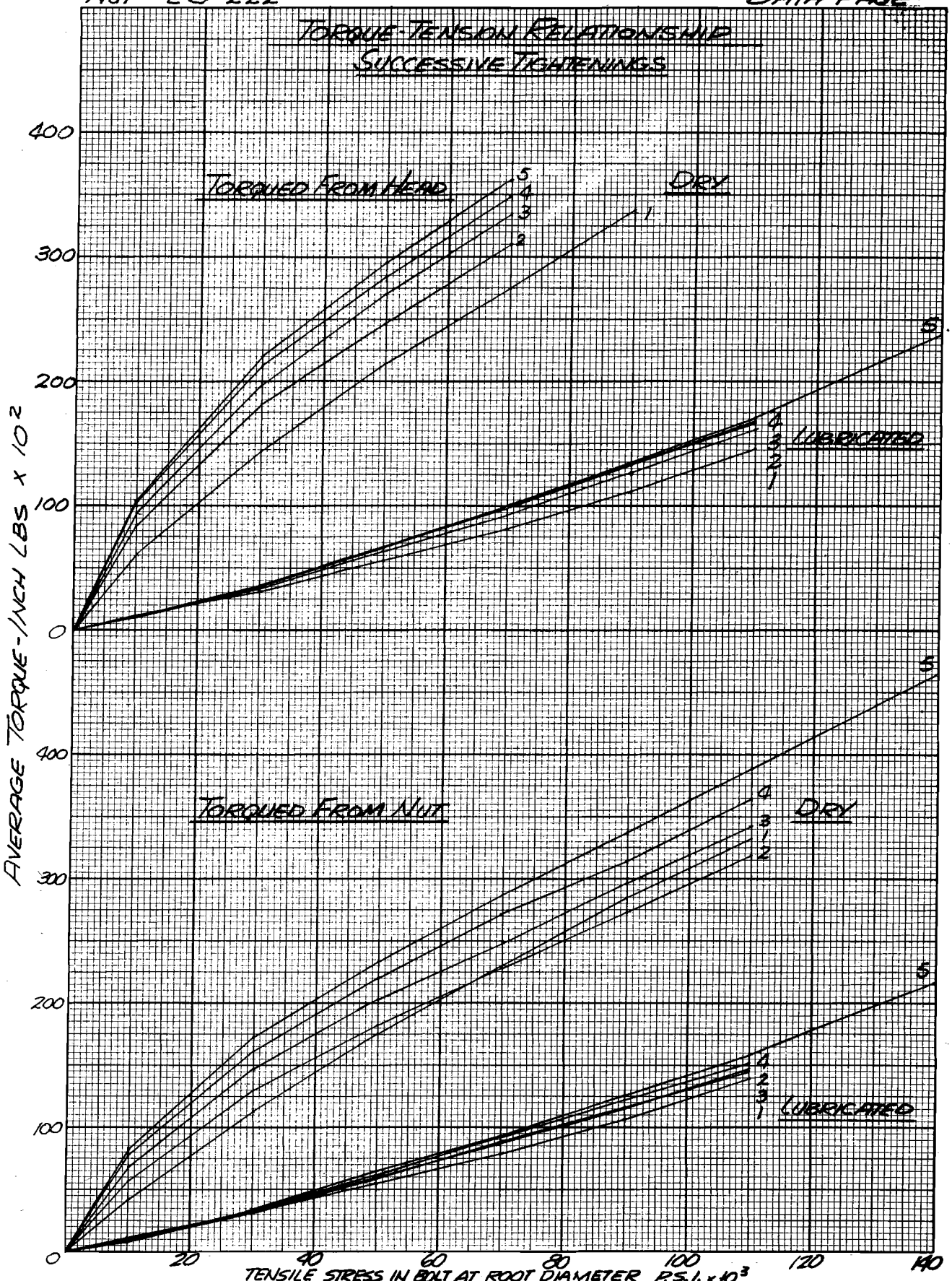
NUT - (3) EB-182, (2) 42 FW-1812 DATA PAGE -



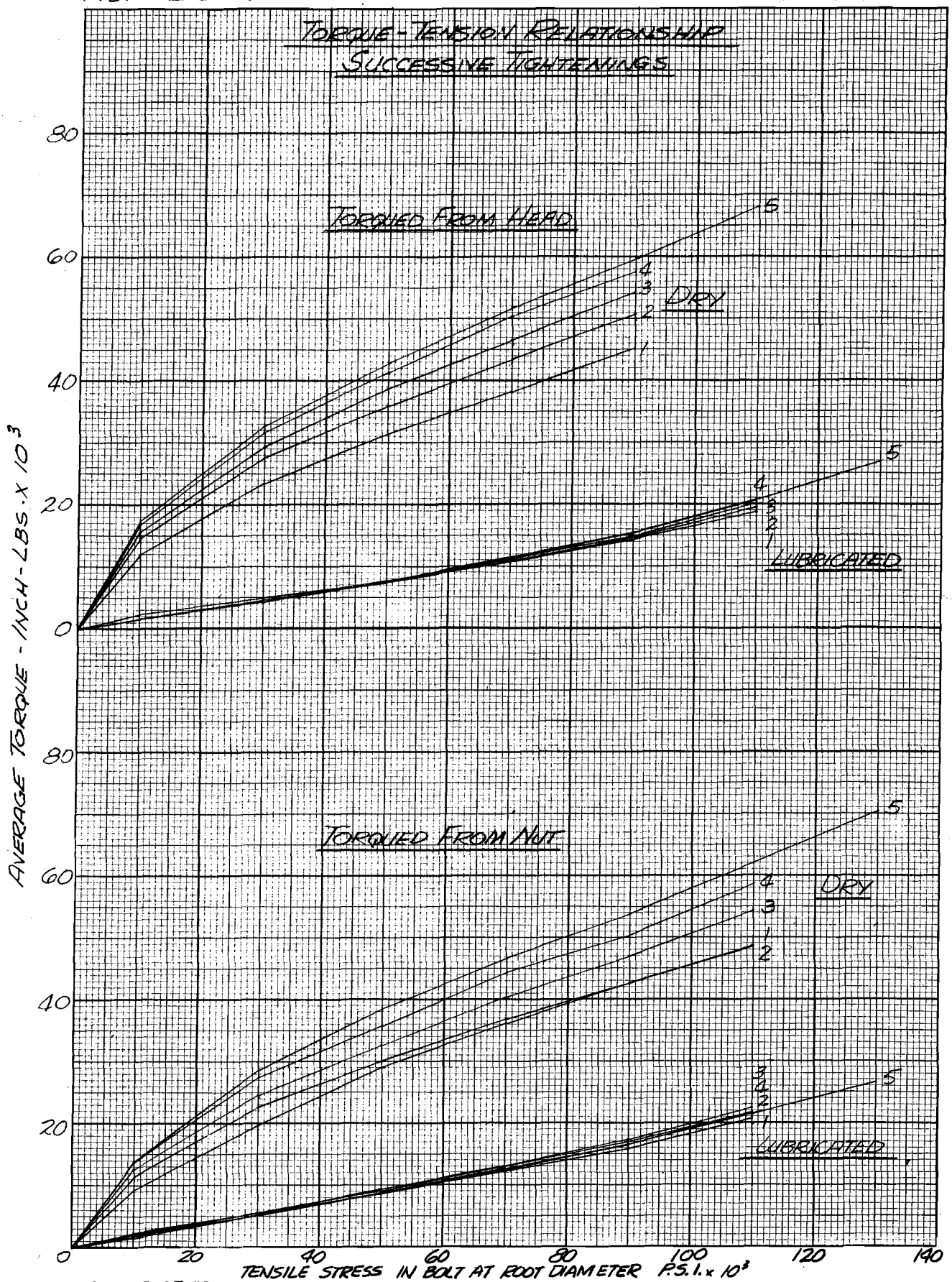
BOLT - MS 20020-50, 1 1/4 - 12 UNF - 3A "L" DATE - 4-5-57
NUT - EB - 202 DATA PAGE



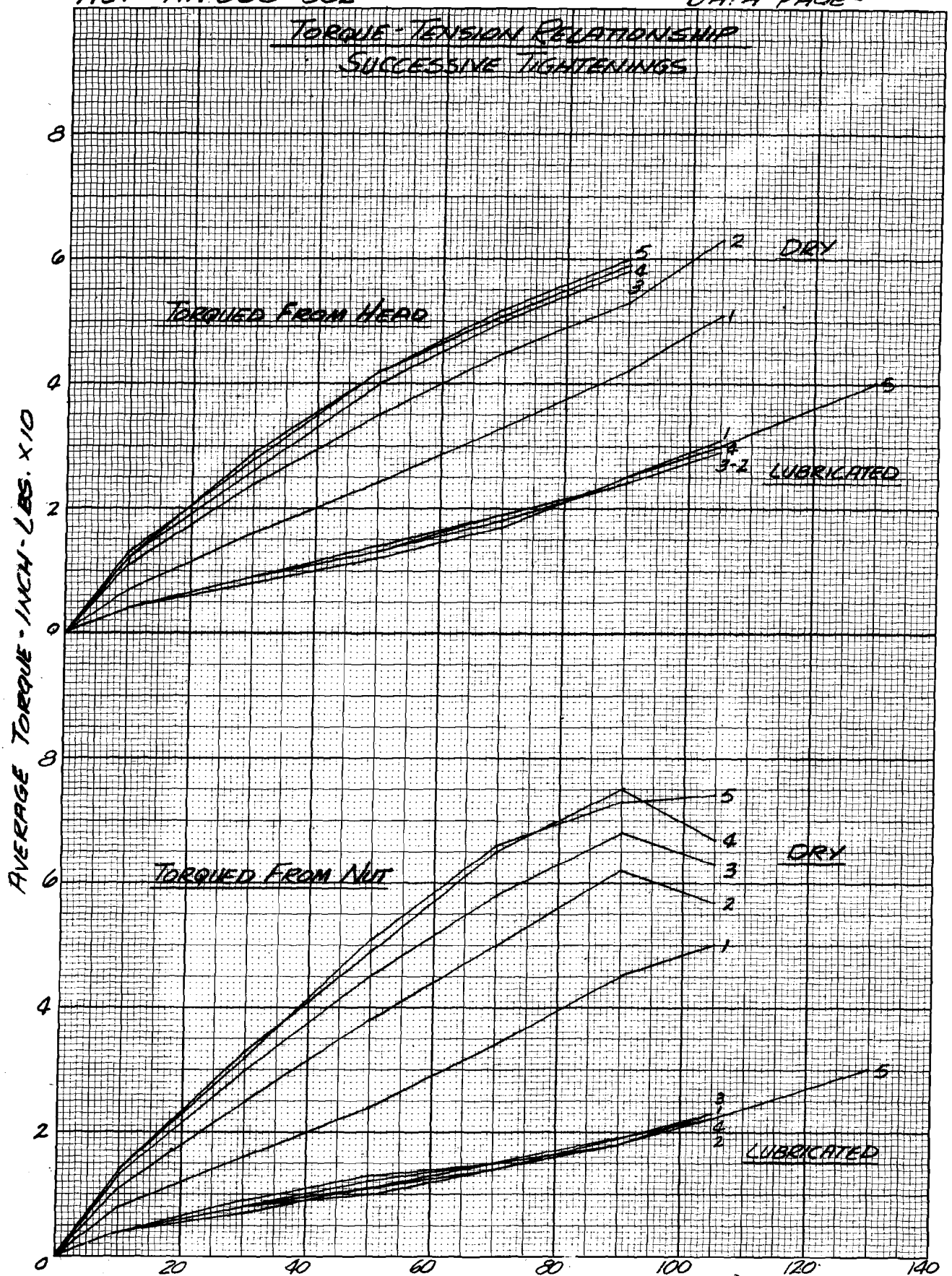
BOLT - MS 20022-52, 1 3/8-12 UNF-3A "M" DATE - 4-12-57
NUT - EB-222 DATA PAGE -



BOLT - MS 20024-52, 1 1/2-12 UNF-3A "N" DATE - 4-19-57
NUT - EB-242 DATA PAGE -



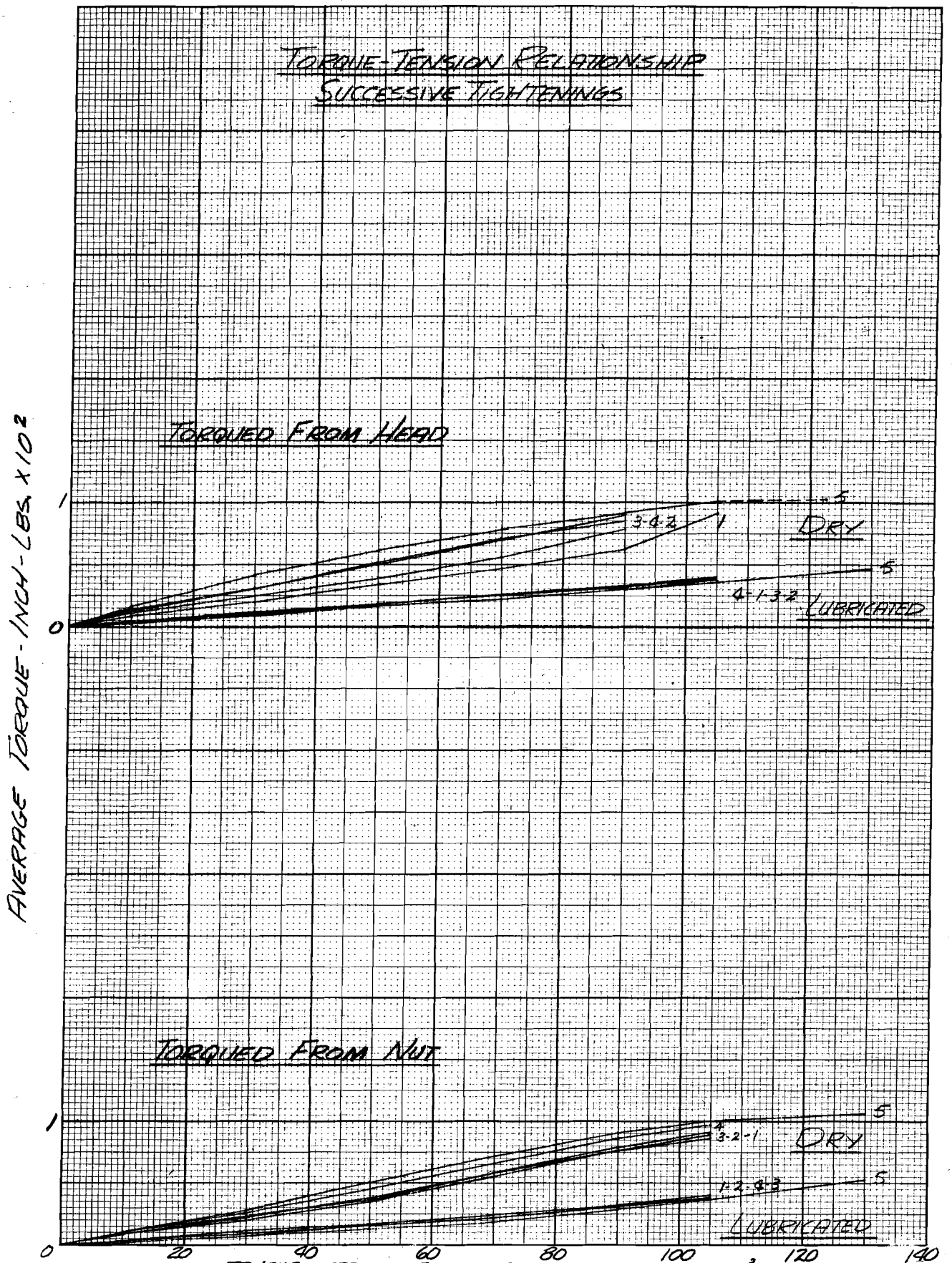
BOLT - AN 509 - 8R 37, 8-32 NF-3A "0" DATE - 1-15-57
NUT - AN 365 - 832 DATA PAGE -



BOLT - AN 509-10R37, 10-32 NF-3A
NUT - AN 365-1032

"P" DATA - PAGE

DATE - 9-30-56

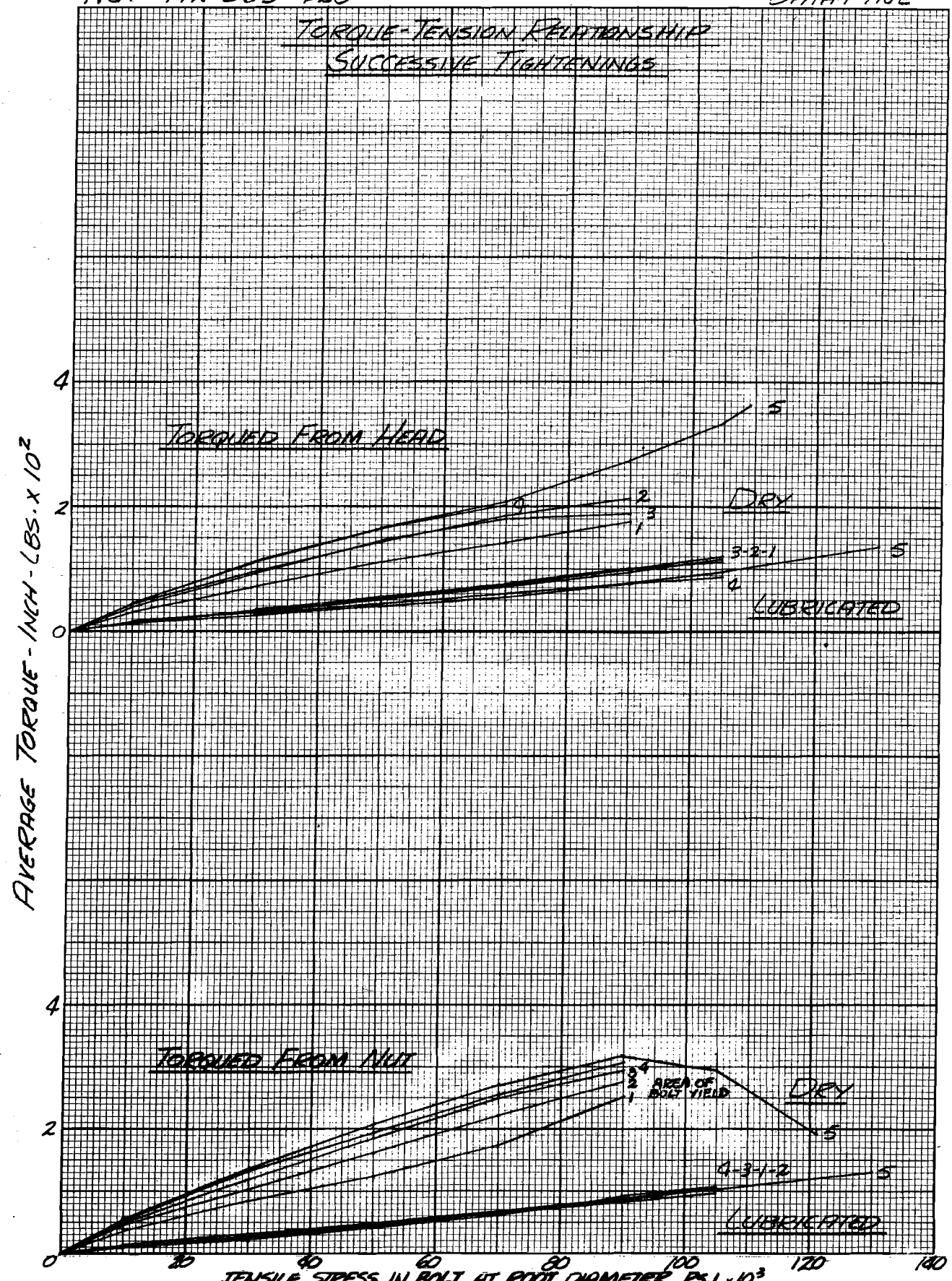


BOLT - AN 509-916 R37, 1/4-28 UNF-3A
NUT - AN 365-928

"Q" DATA-PAGE

DATE - 4-24-56

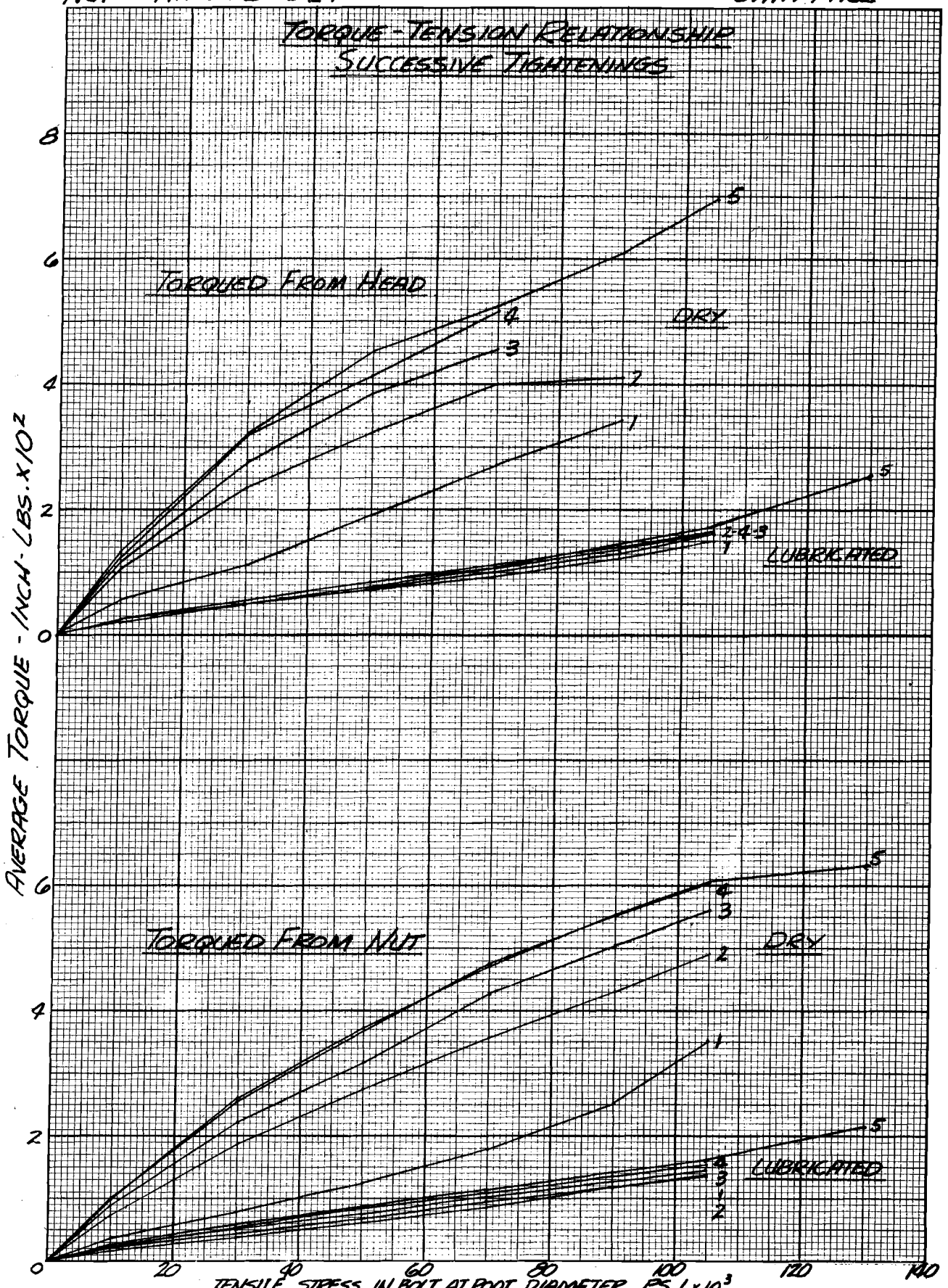
TORQUE-TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS



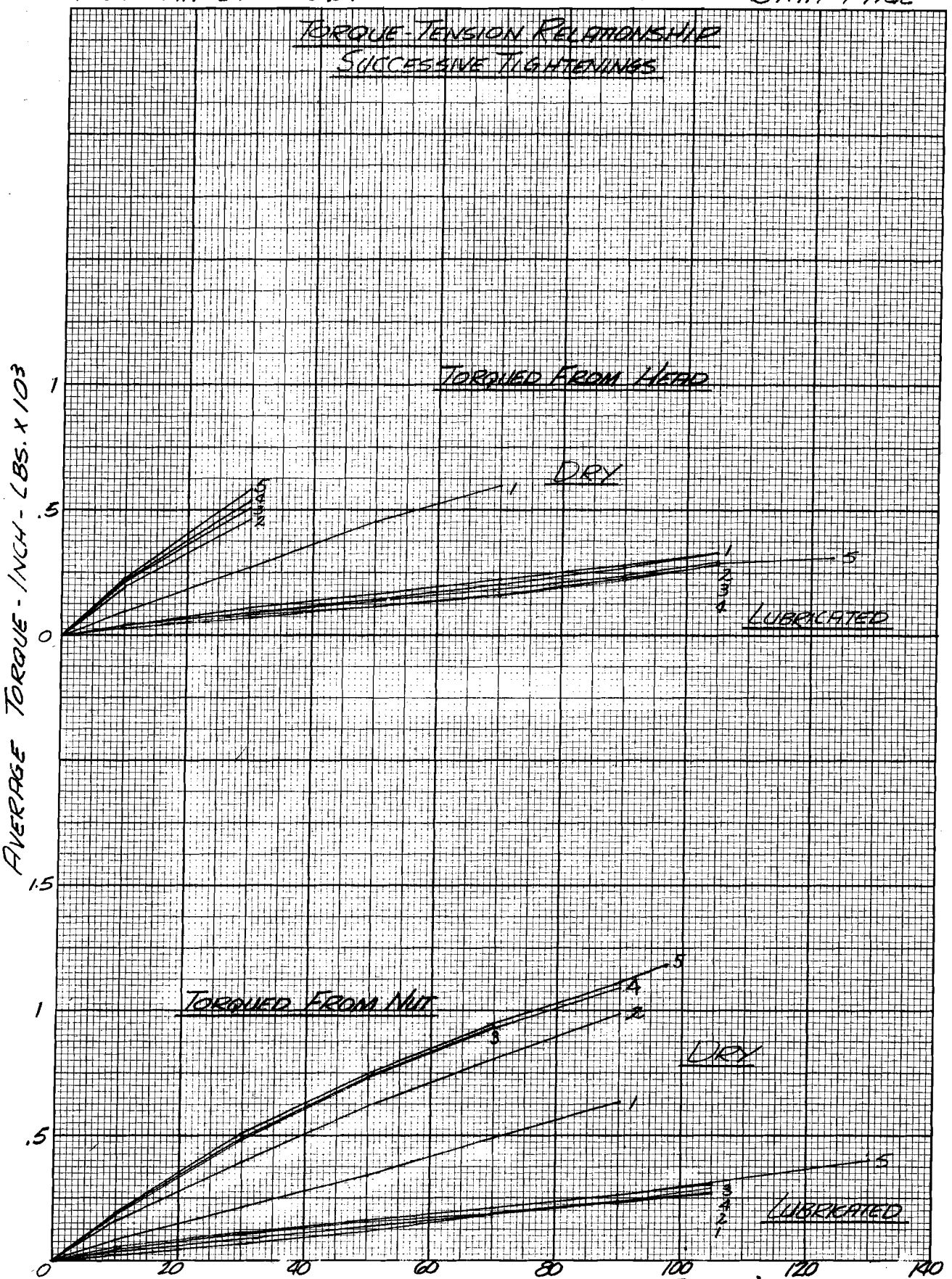
WADC TR 57-330

BOLT - AN 509-516 R 48, 5/16-24 UNF-3A "R" DATE - 1-16-57

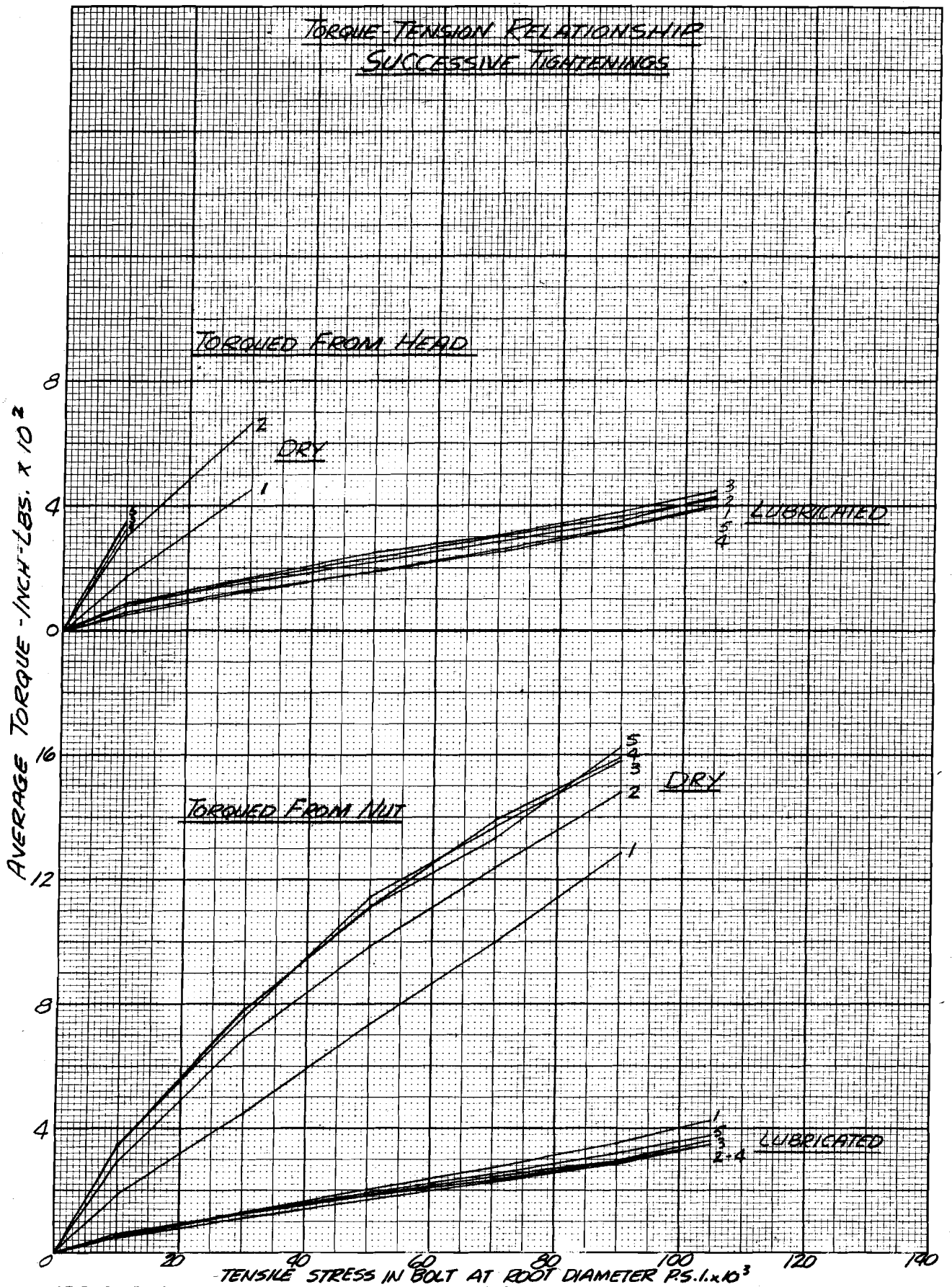
NUT - AN 365-524 DATA PAGE -



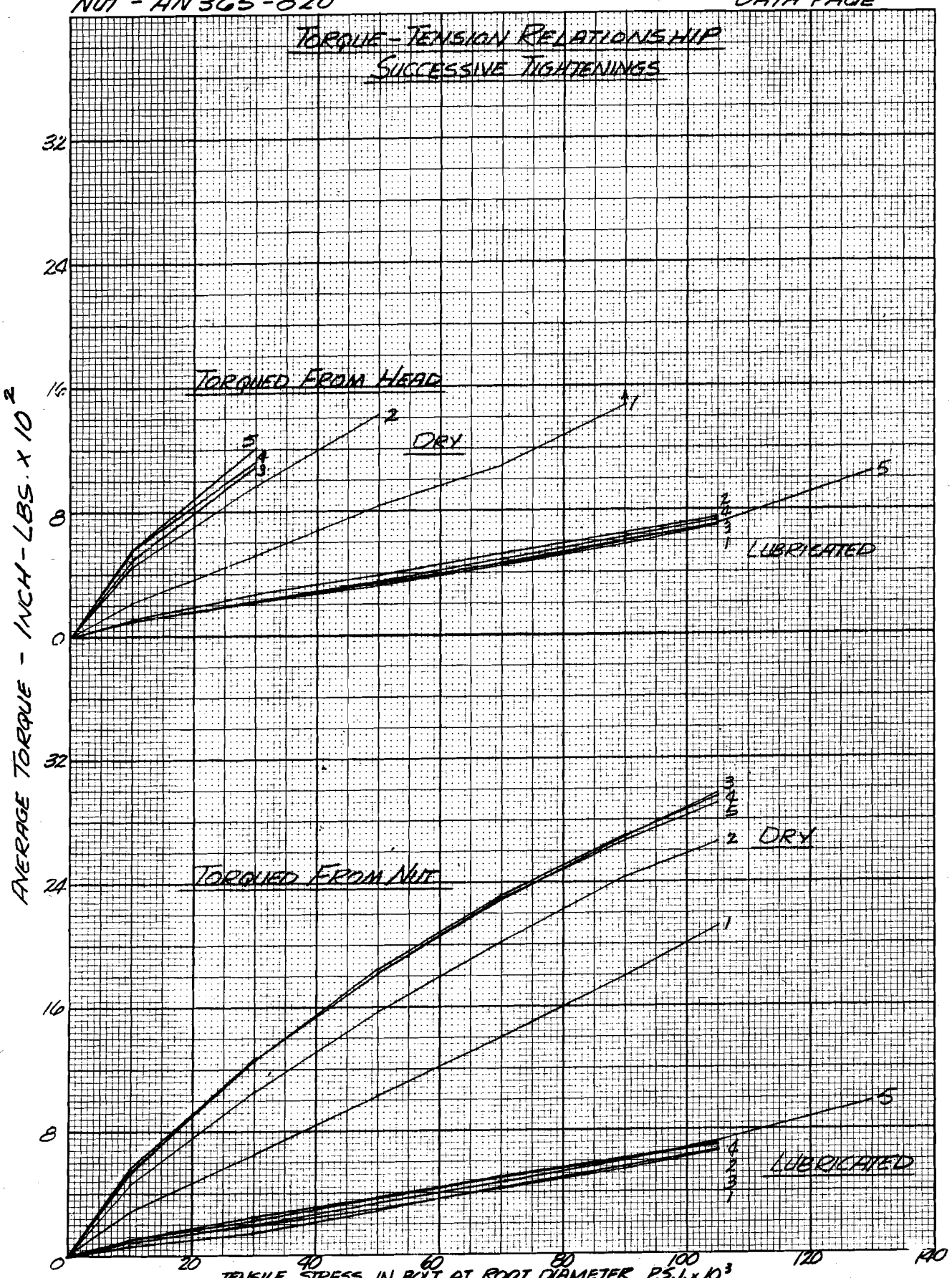
BOLT - AN 509-616 R48, 3/8-24 UNF-3A "S" DATE - 5-3-56
NUT - AN 365-624 DATA - PAGE -



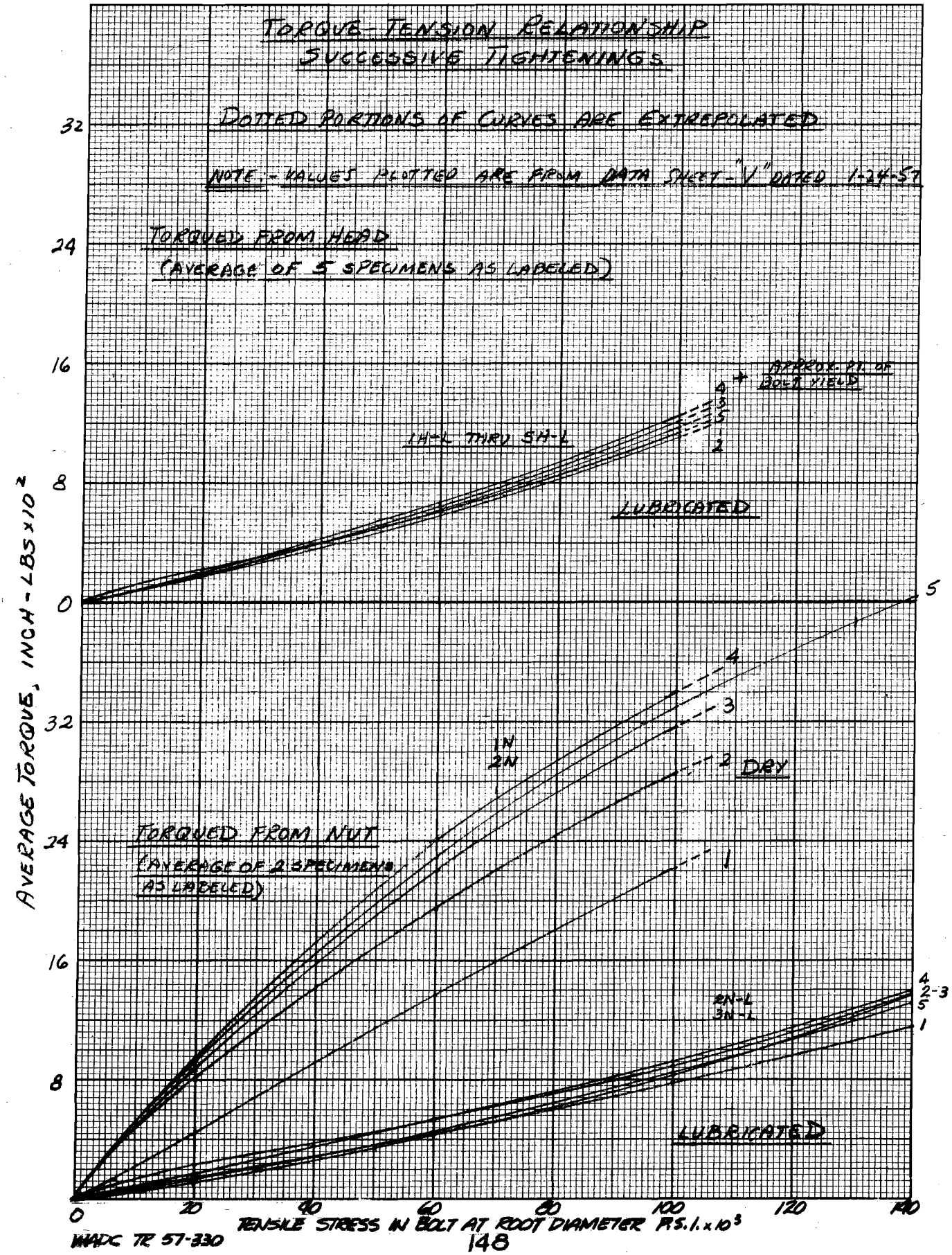
BOLT · AN 509-716 R 48, 7/16-20 UNF-3A "T" DATE - 1-18-57
NUT - AN 365-720 DATA PAGE



BOLT - AN 509-816R49, 1/2-20 UNF-3A "U" DATE - 1-22-57
NUT - AN 365-820 DATA PAGE -



BOLT AN509-916R52, 9/16-18UNF-3A "V" DATE-1-25-57
NUT AN365-918 DATA PAGE -

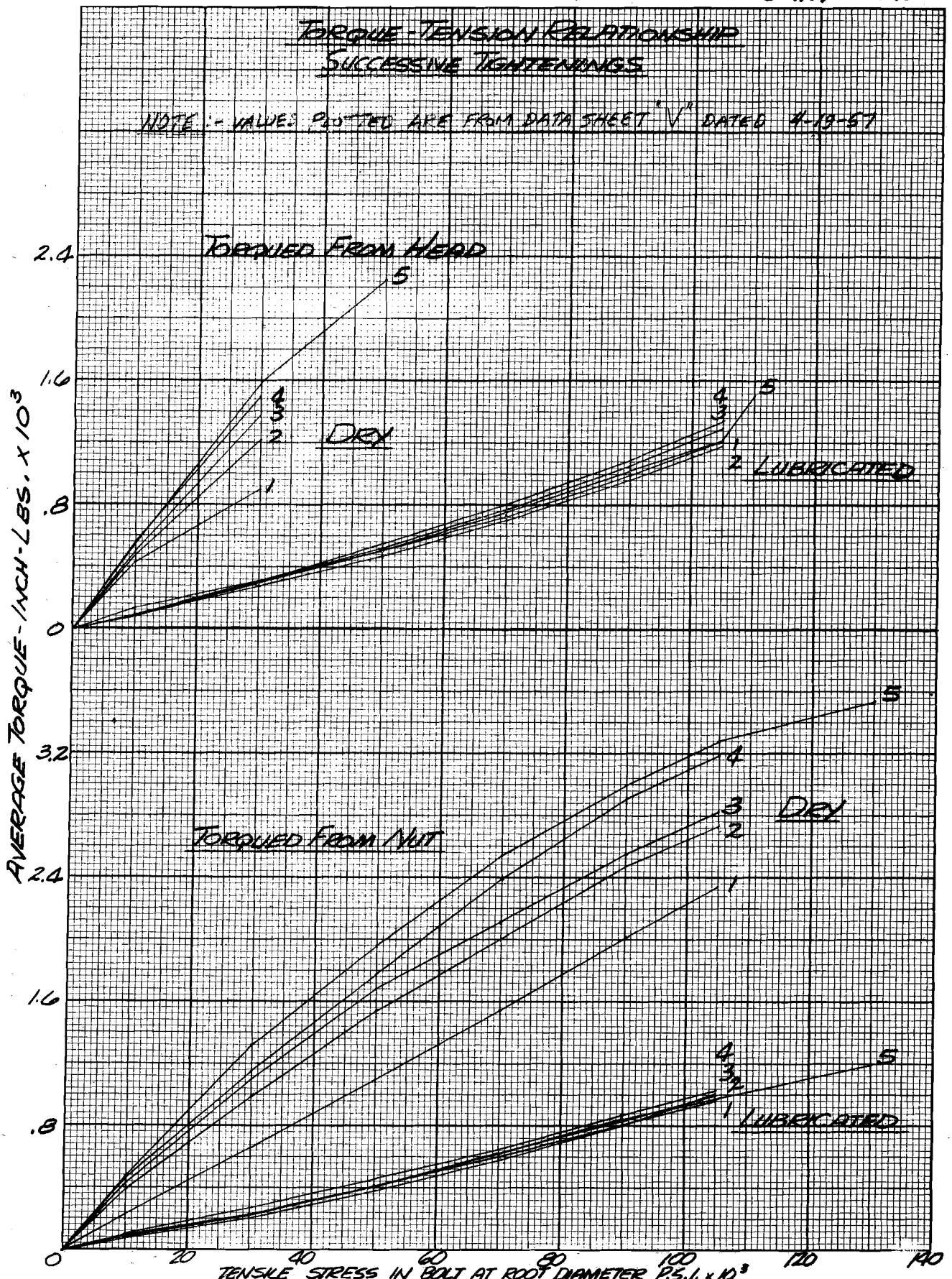


BOLT - AN 509-916 R 52, 9/16-18 UNF-3A "V"
NUT - AN 365-918

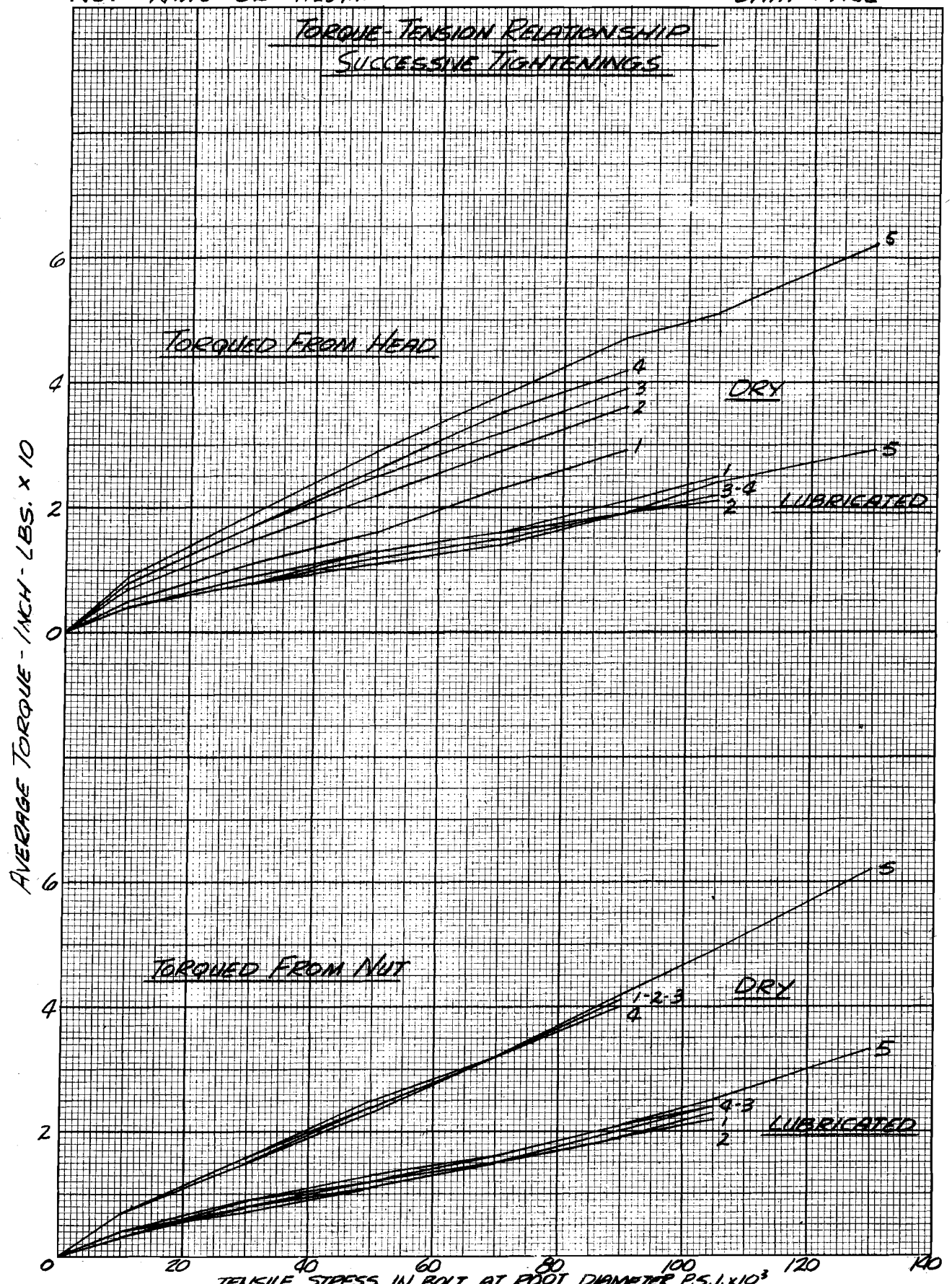
DATE - 4-22-57
DATA PAGE -

TORQUE - TENSION RELATIONSHIP
SUCCESSIVE TIGHTENINGS

NOTE :- VALUES PLOTTED ARE FROM DATA SHEET "V" DATED 4-19-57



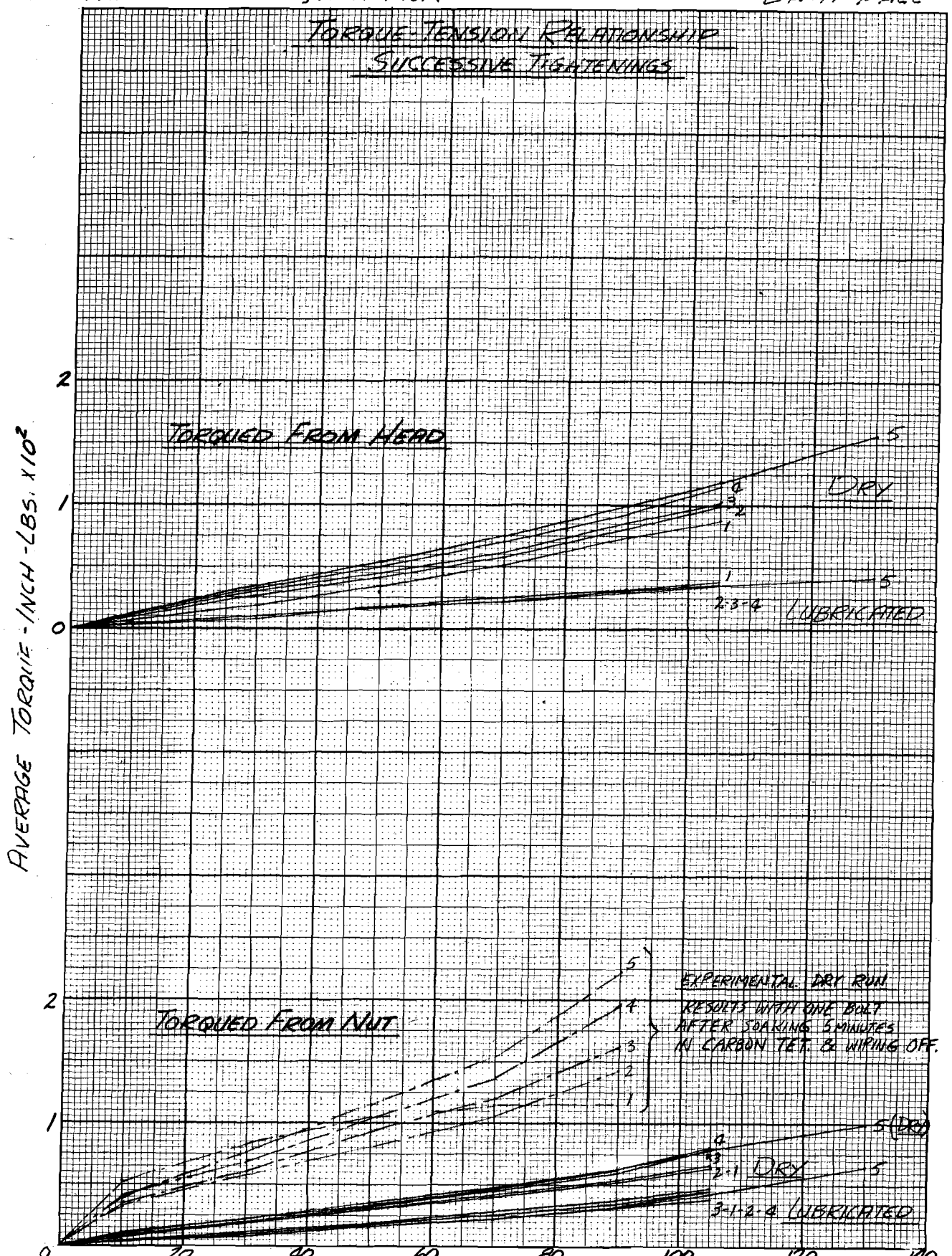
BOLT - AN 509 - 8 R 37, 8-32 NF-3A "W" DATE - 1-15-57
NUT - NMJ-82 ALUM. DATA PAGE -



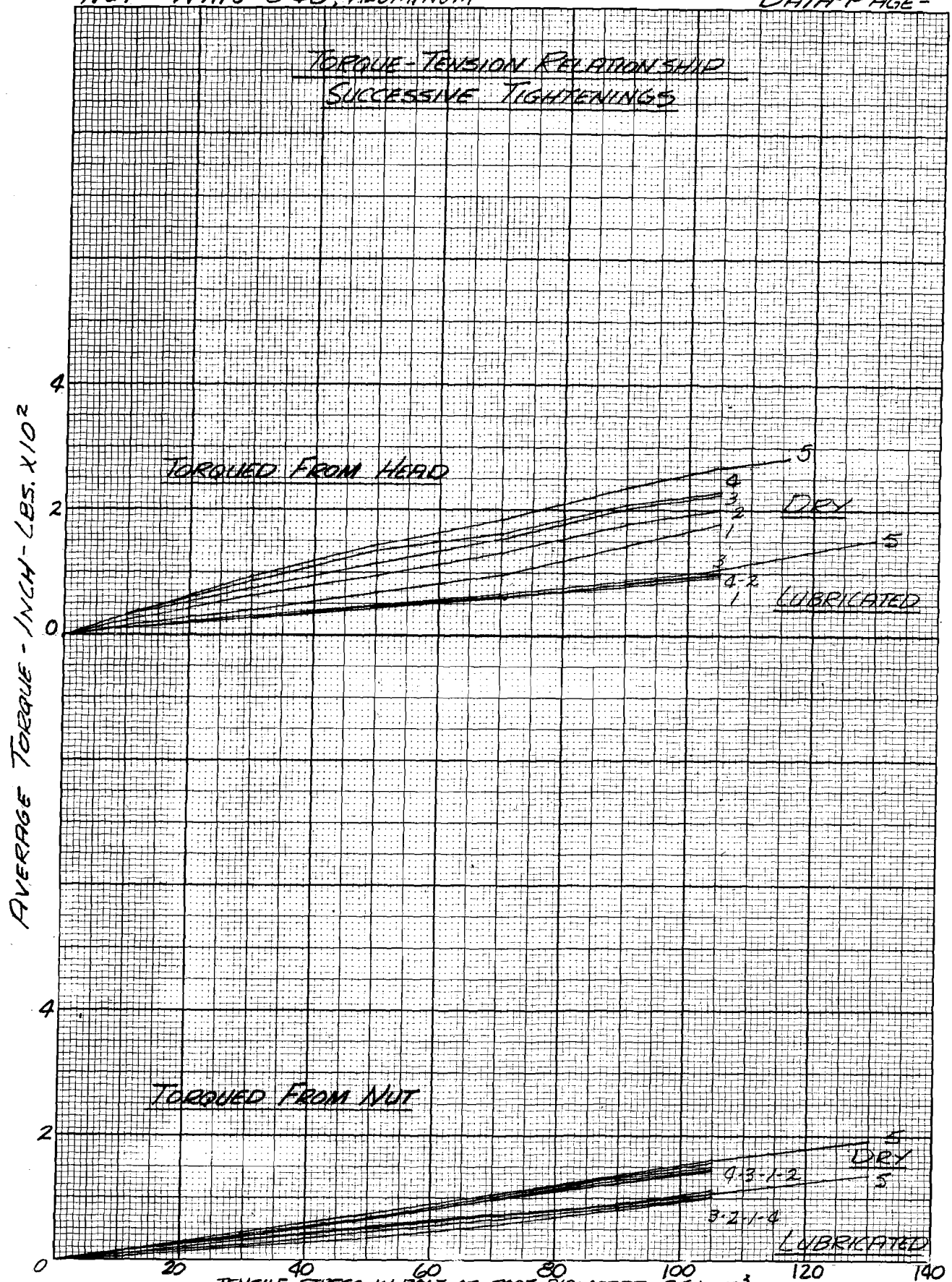
BOLT - AN 509-10R37, 10-32 NF-3A
NUT - NMJ-02, ALUMINUM

"X"

DATE - 4-27-56
DATA - PAGE



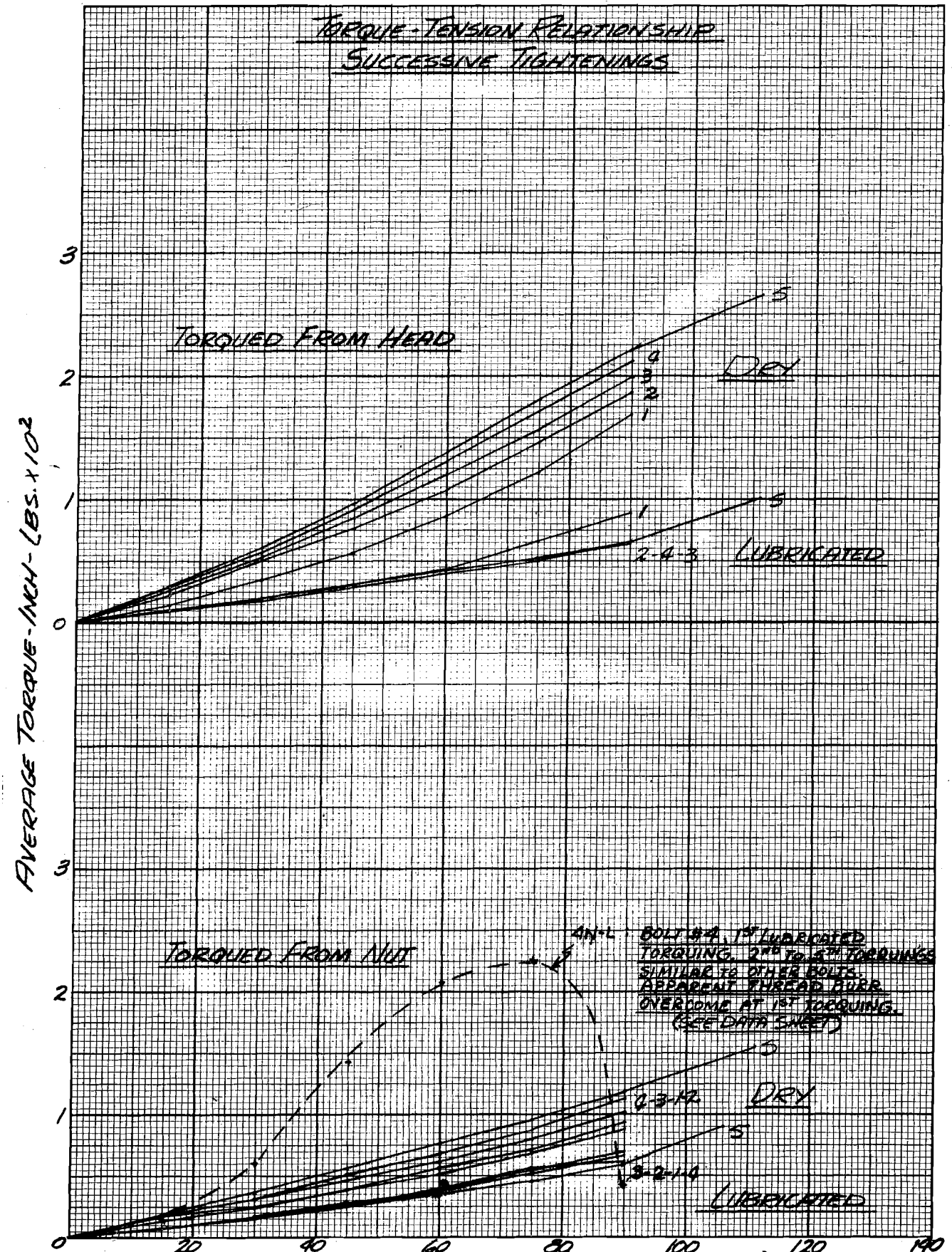
BOLT - AN 509-916 R37, 1/2-28UNF-3A "Y" DATE- 9-23-56
NUT - NMJ-008, ALUMINUM DATA-PAGE-



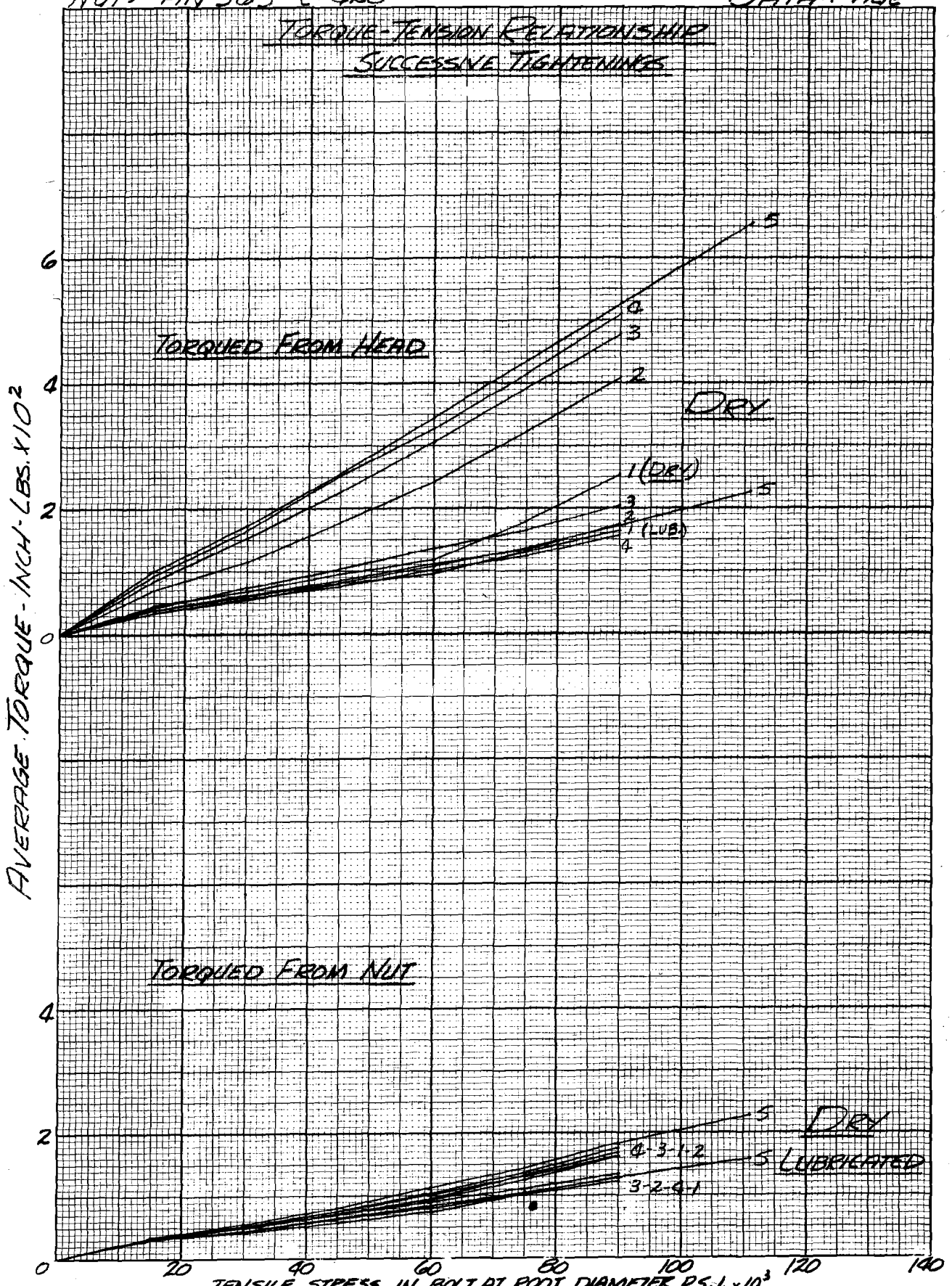
BOLT - AN 3C-30, 10-32 NF-3A
NUT - AN-363-C-1032

"A-A"

DATE - 9-16-56
DATA - PAGE

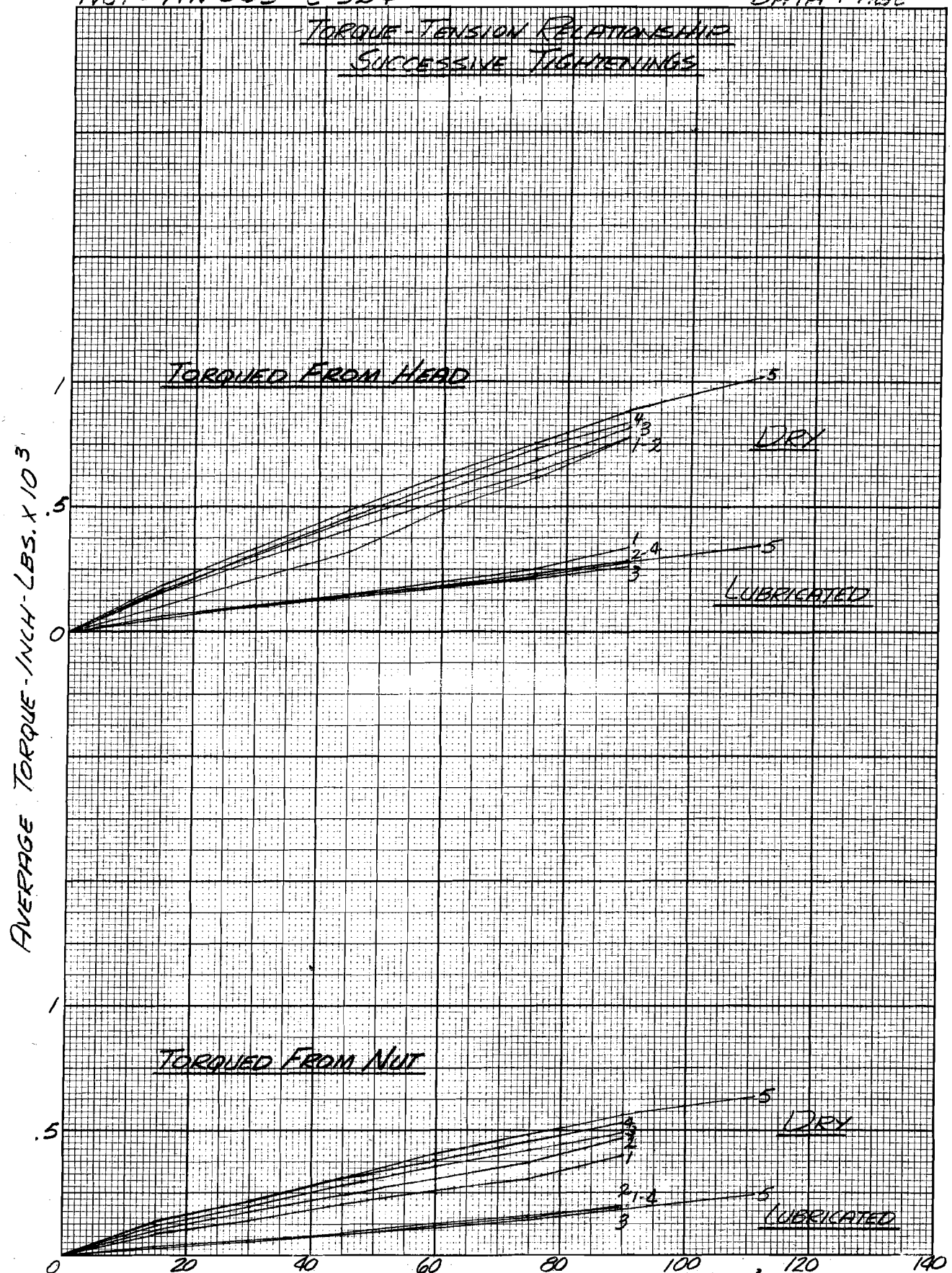


BOLT - AN 4C-30, 1/4-28 UNF-3A "B-B" DATE - 4-18-56
NUT - AN 363-C-428 DATA PAGE



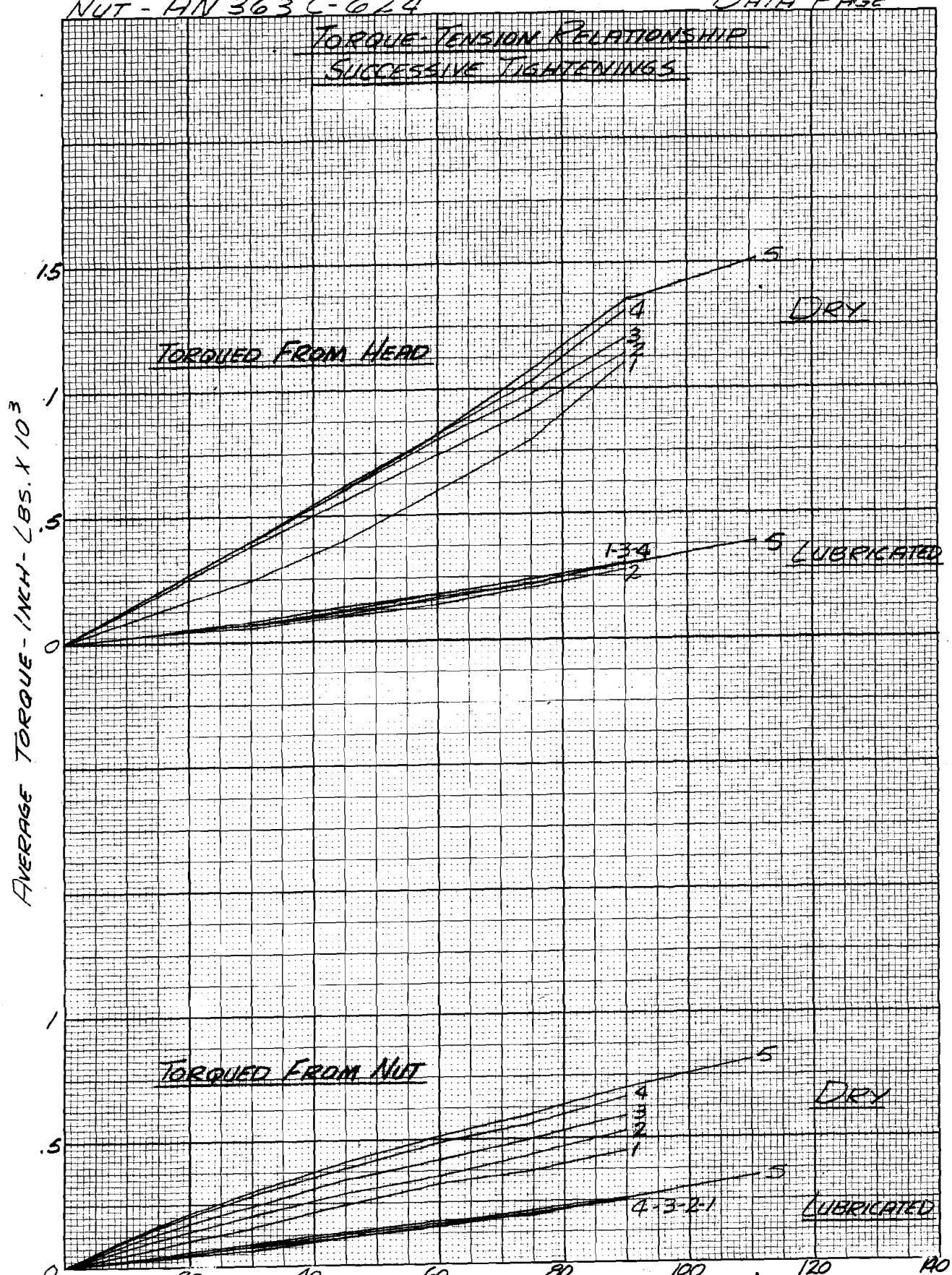
BOLT - AN 5C-35, 5/16-24 UNF-3A "C-C" DATE - 4-11-56

NUT - AN 363-C 524 DATA PAGE -

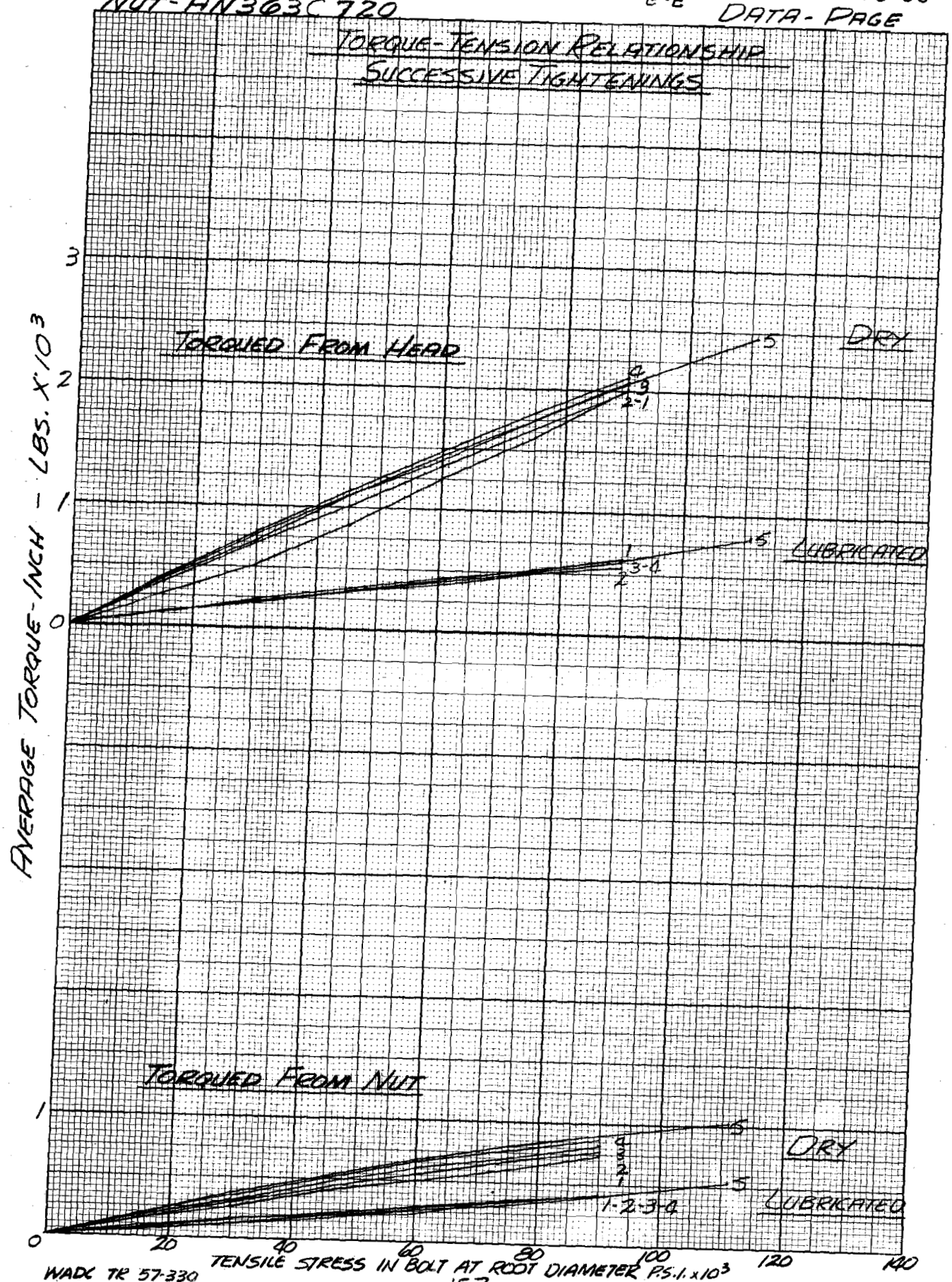


BOLT - AN 6C-36 3/8-24 UNF-3A "D-D" DATE - 3-27-56

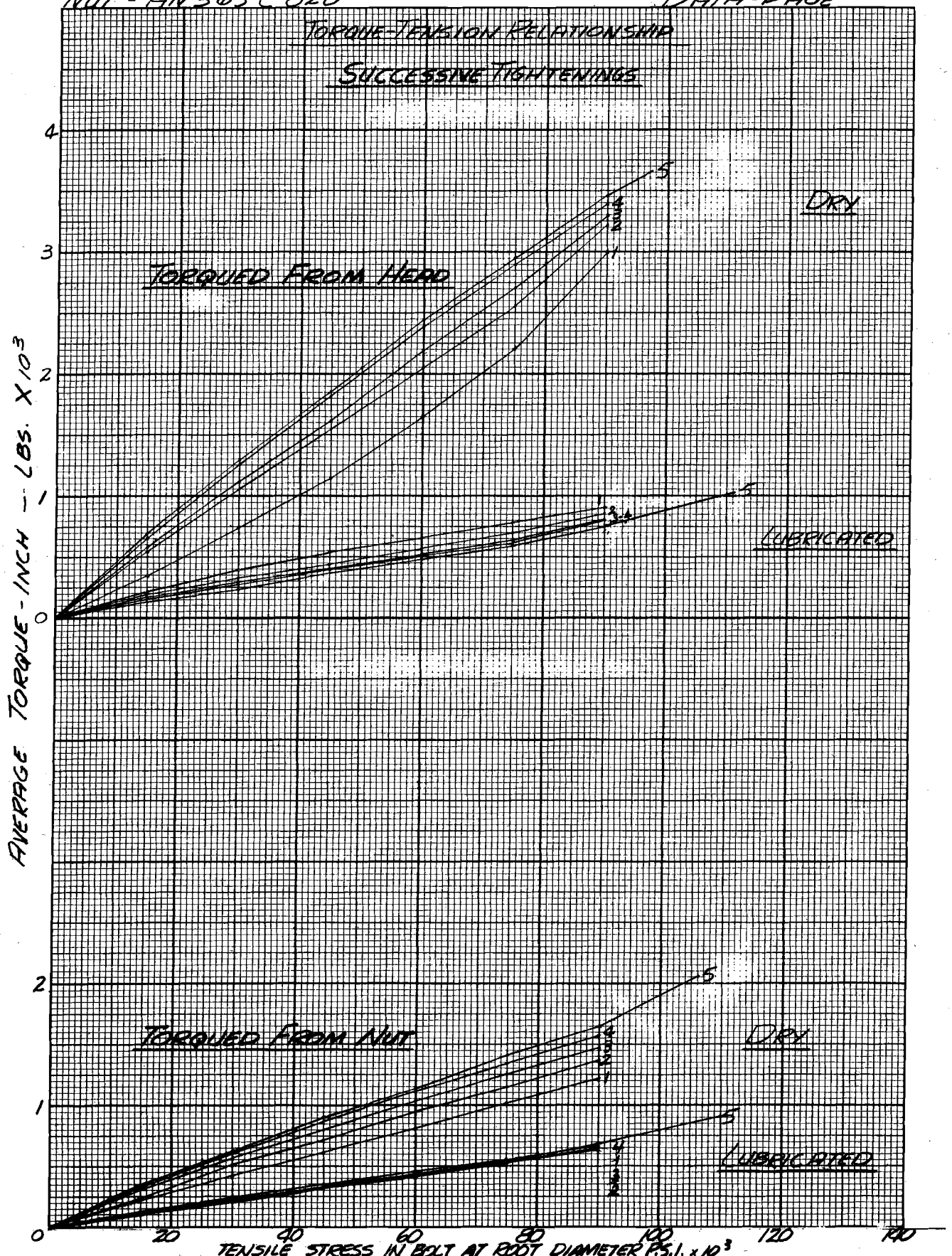
NUT - AN 363 C-624 DATA PAGE



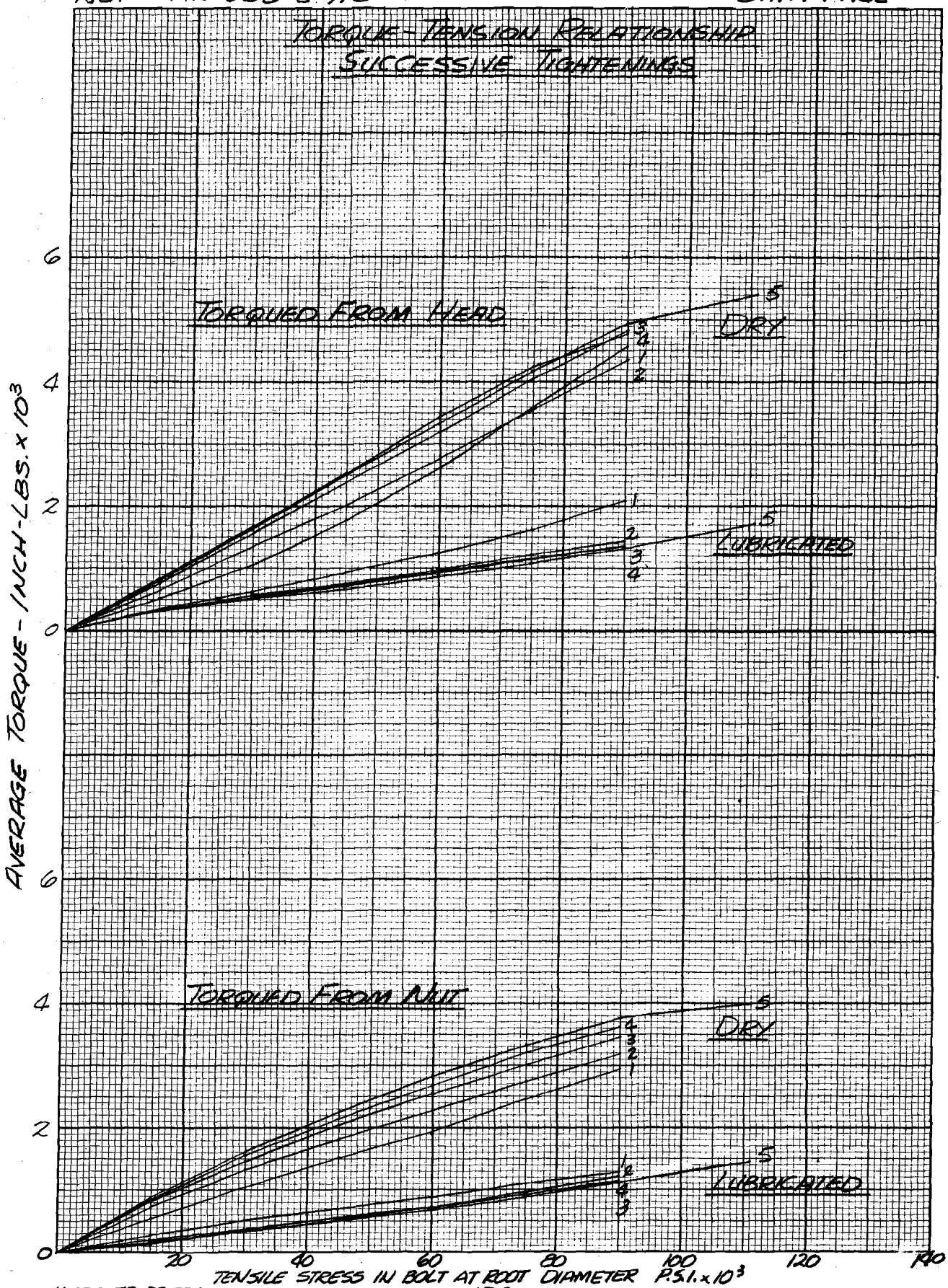
BOLT - AN7C-36, 7/16-20UNF-3A "E-E" DATE - 3-23-56
NUT - AN363C720 DATA - PAGE



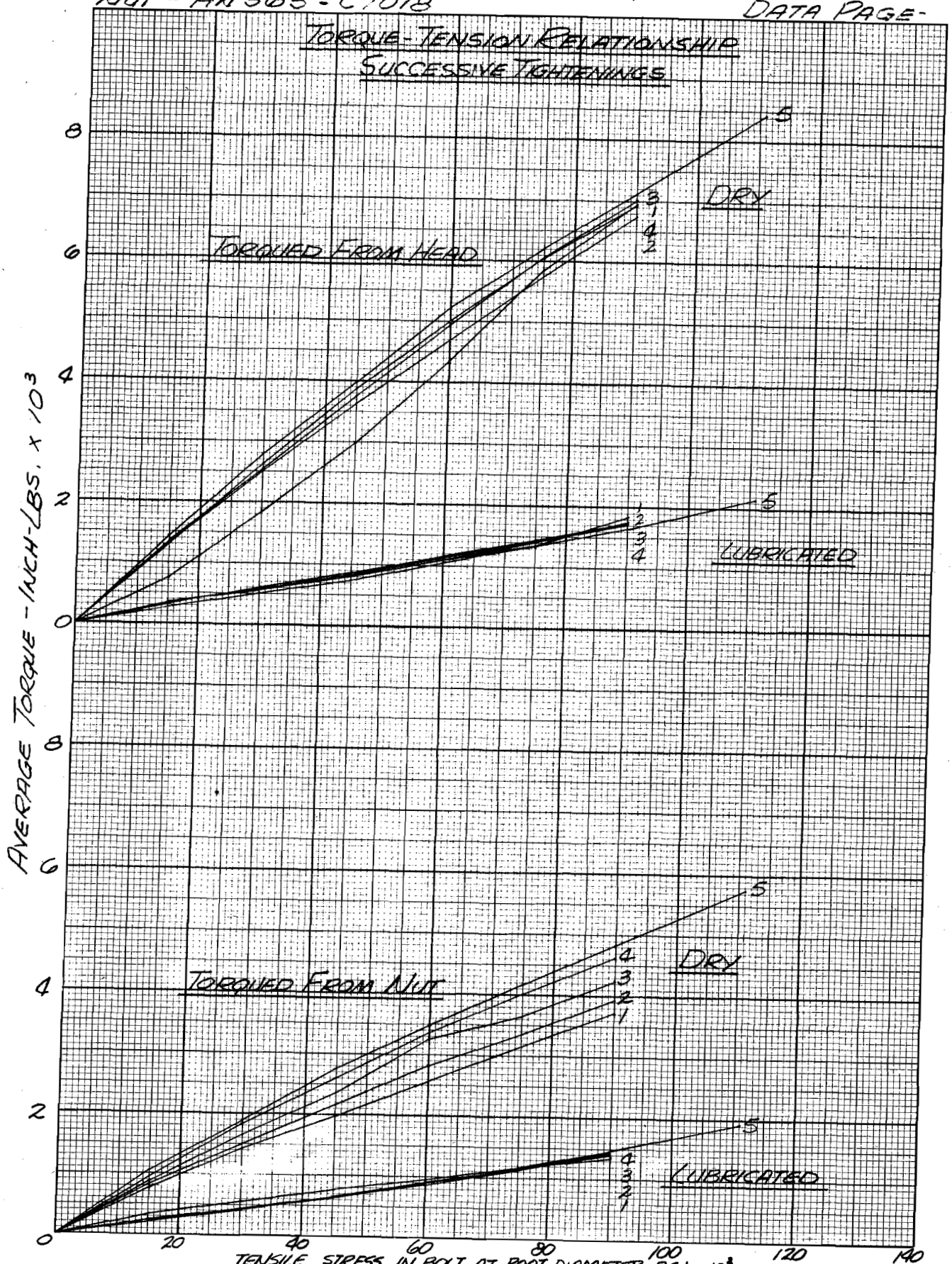
BOLT - AN8C-37, 1/2-20UNF-3A "F-F" DATE - 3-15-56
NUT - AN363C820 DATA-PAGE



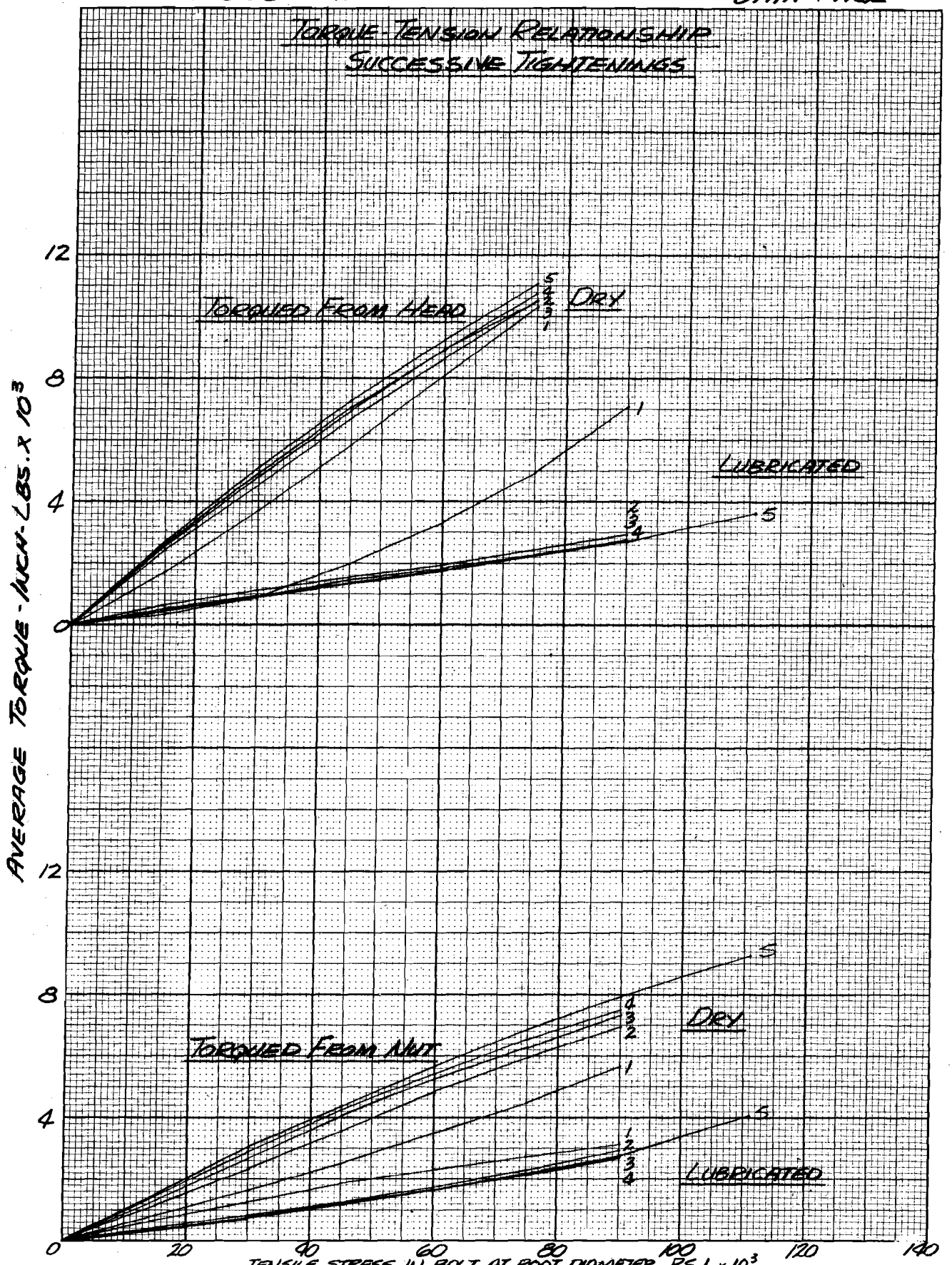
BOLT - AN 9C 37, 9/16-18 UNF-3A "G-G" DATE - 1-30-57
NUT - AN 363-C 9/8 DATA PAGE -



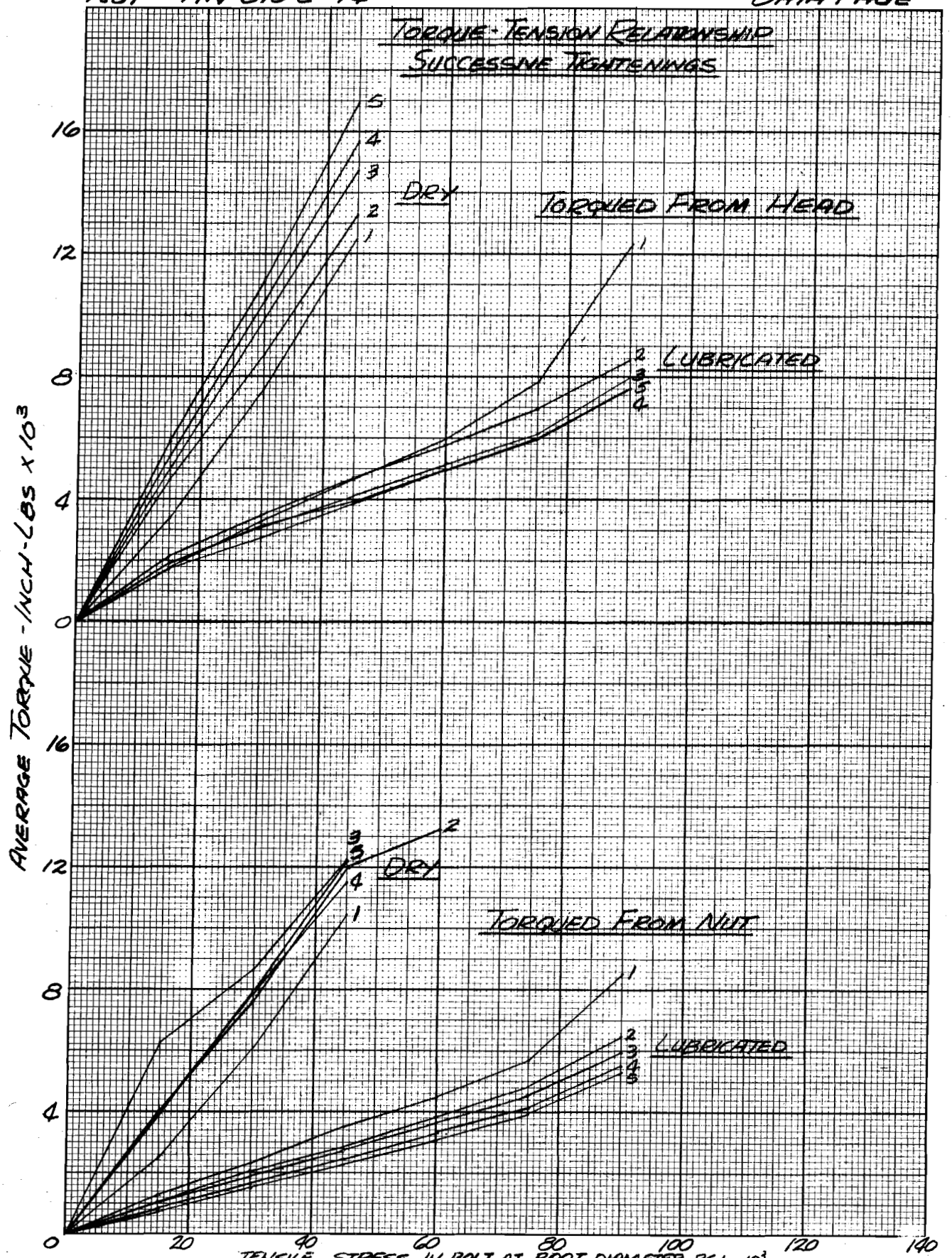
BOLT - AN 10C-27 5/8-18 UNF-3A "H-H" DATE-2-1-57
NUT - AN 363 - C 1018 DATA PAGE-



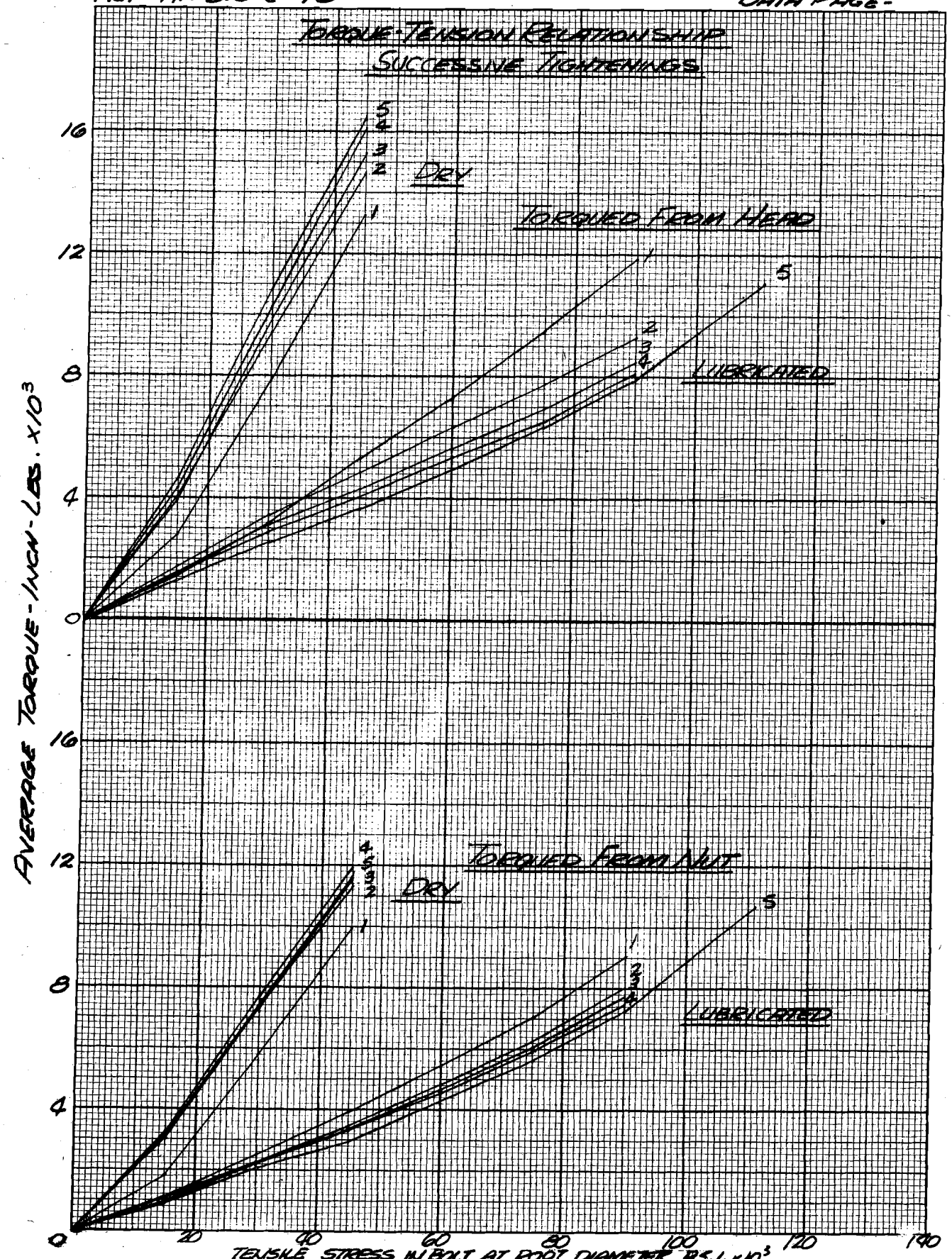
BOLT - AN 12C-41, 3/4-16 UNF-3A "I-I" DATE - 2-13-57
NUT - AN 363-C 1216 DATA PAGE -



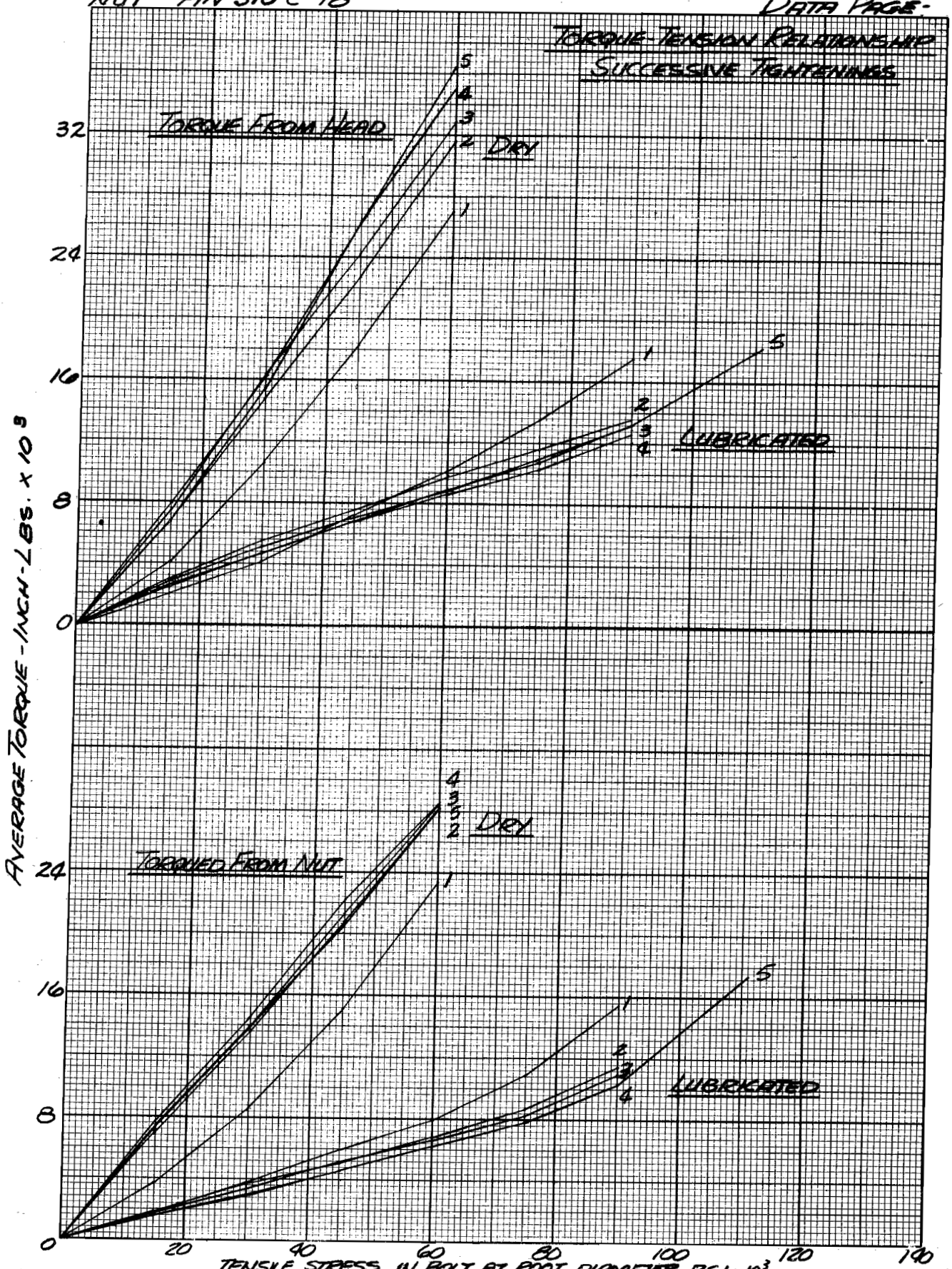
BOLT - AN 14C-42, 7/8-14-UNF-3A "J-J" DATE - 2-19-57
NUT - AN 310 C-14 DATA PAGE



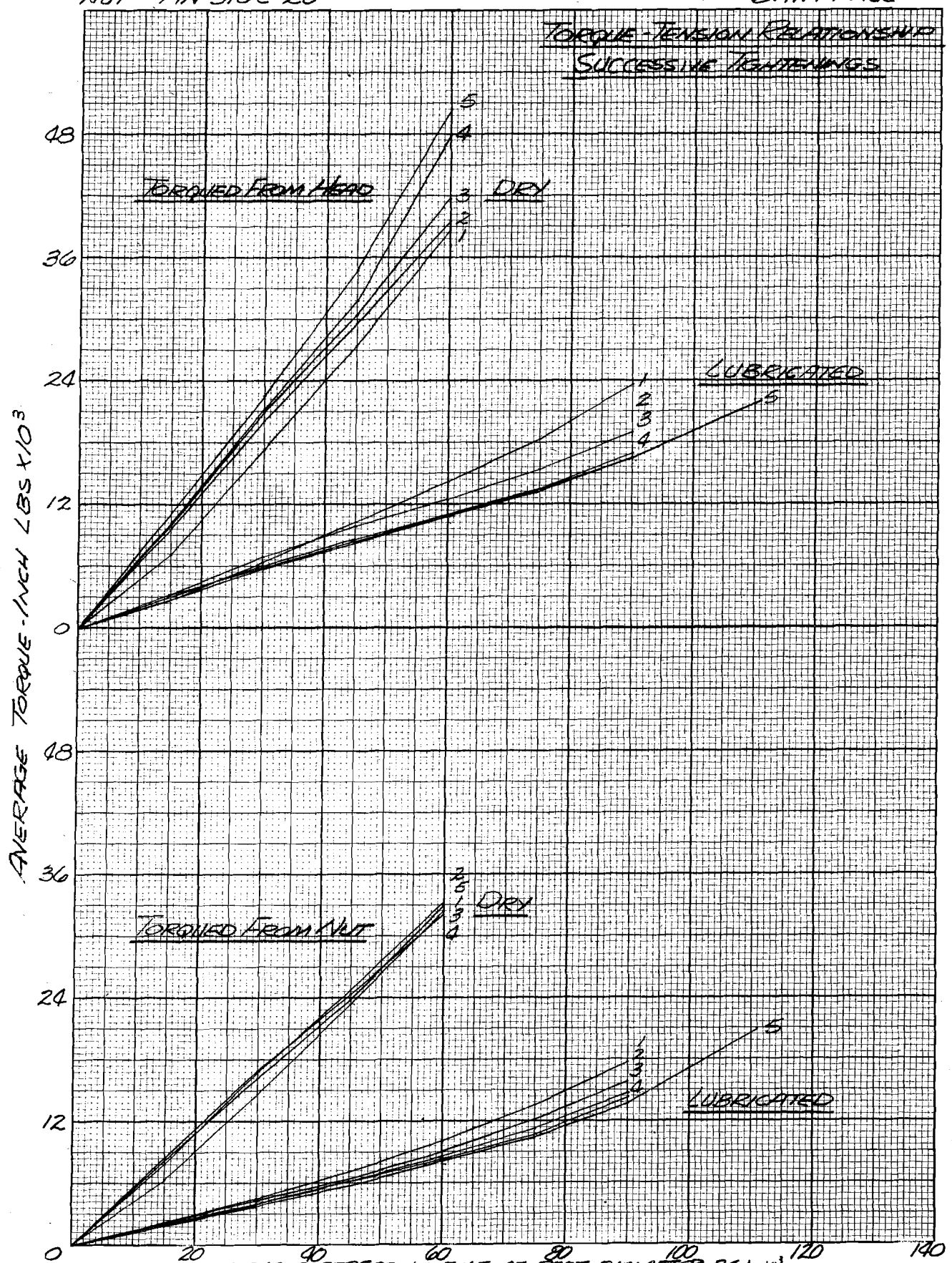
BOLT - AN 16 C-42, 1-14 NF-3A "K-K" DATE - 3-20-57
NUT - AN 310 C-16 DATA PAGE -

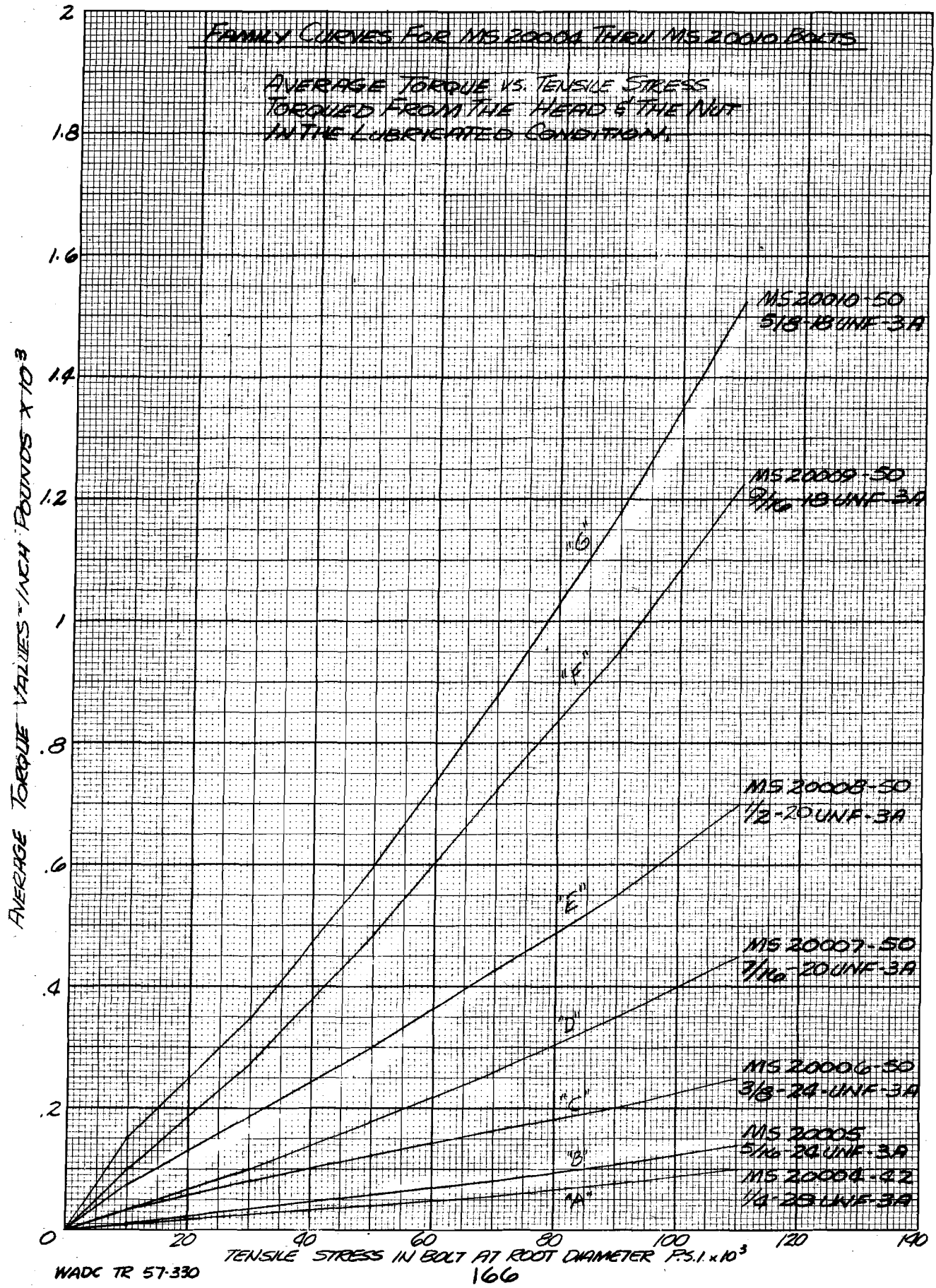


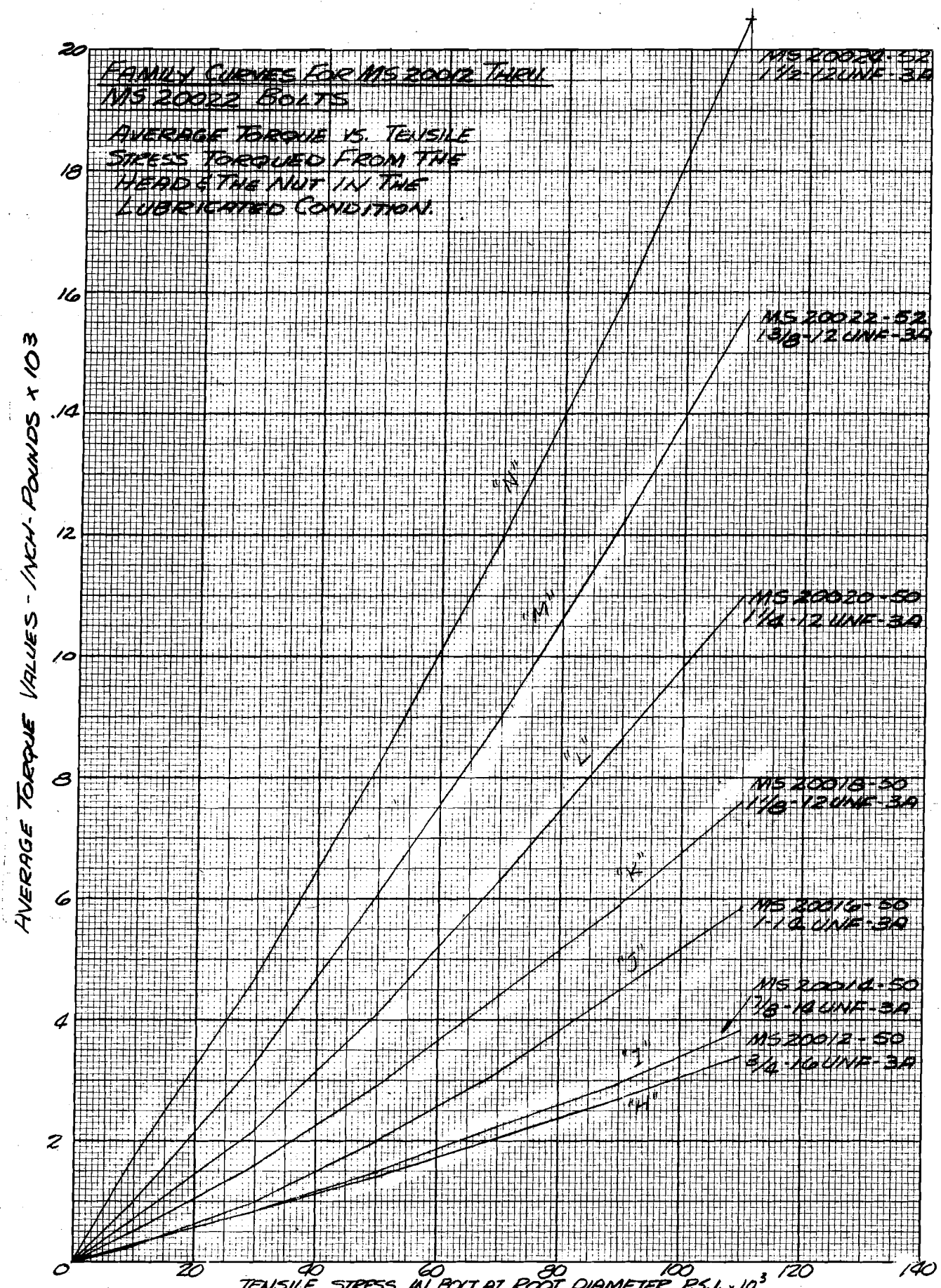
BOLT - AN 18C-44, 1 1/8-12 UNF-3A "L-L" DATE - 3-27-57
NUT - AN 310 C-18 DATA PAGE -

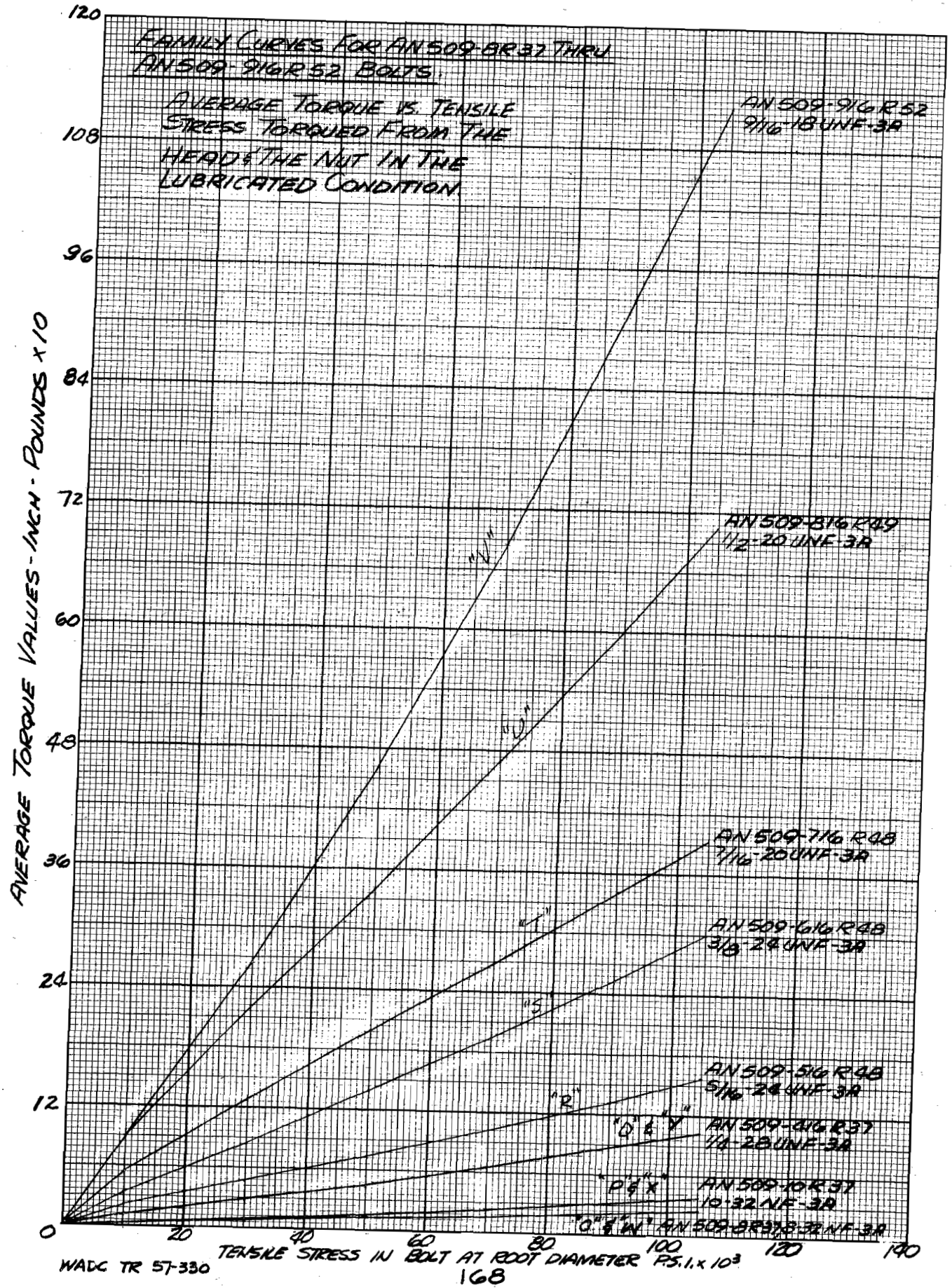


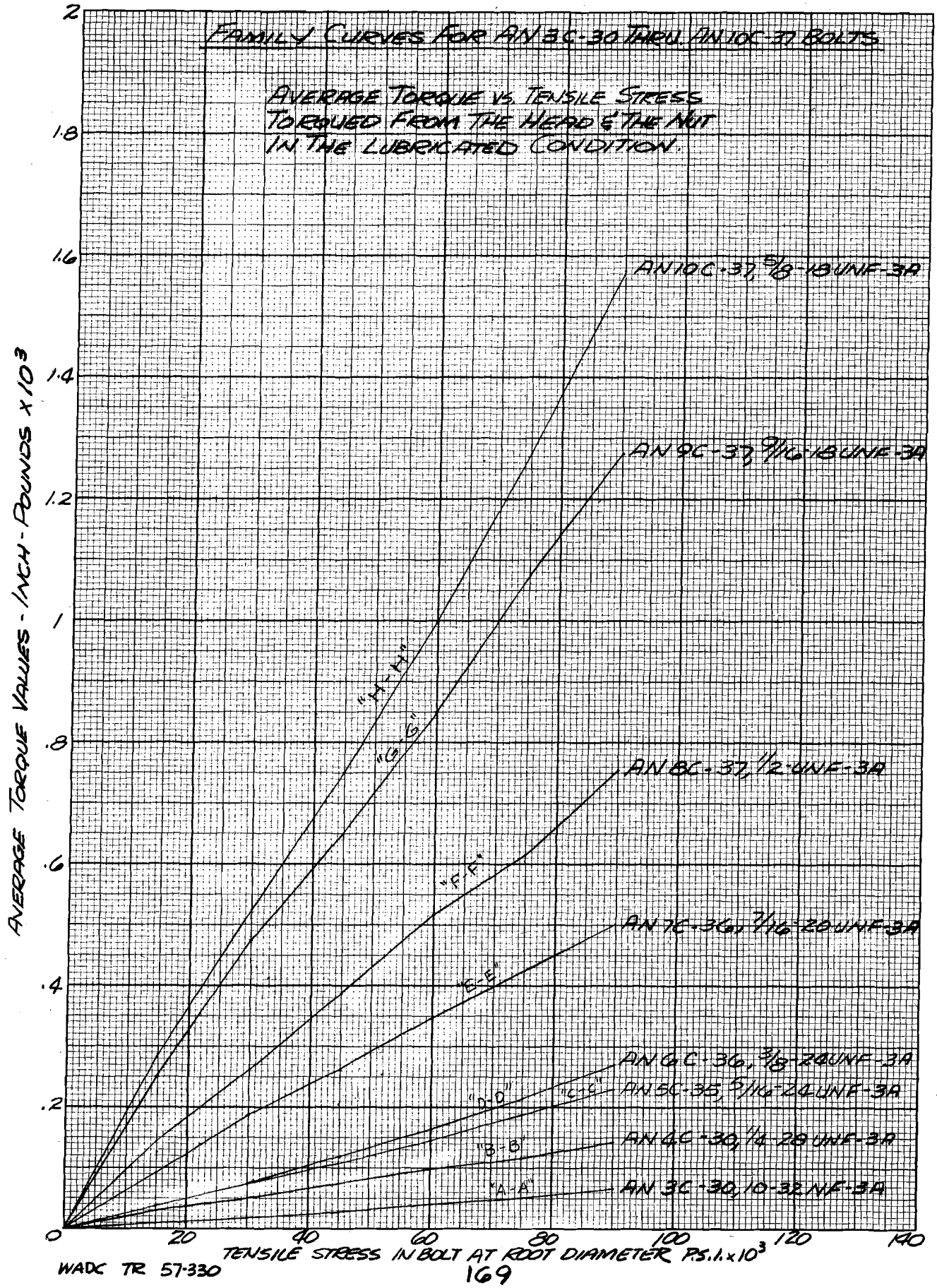
BOLT - AN 20C-45, 1 1/4-12 UNF 3A "M-M" DATE - 4-9-57
NUT - AN 310C 20 DATA PAGE

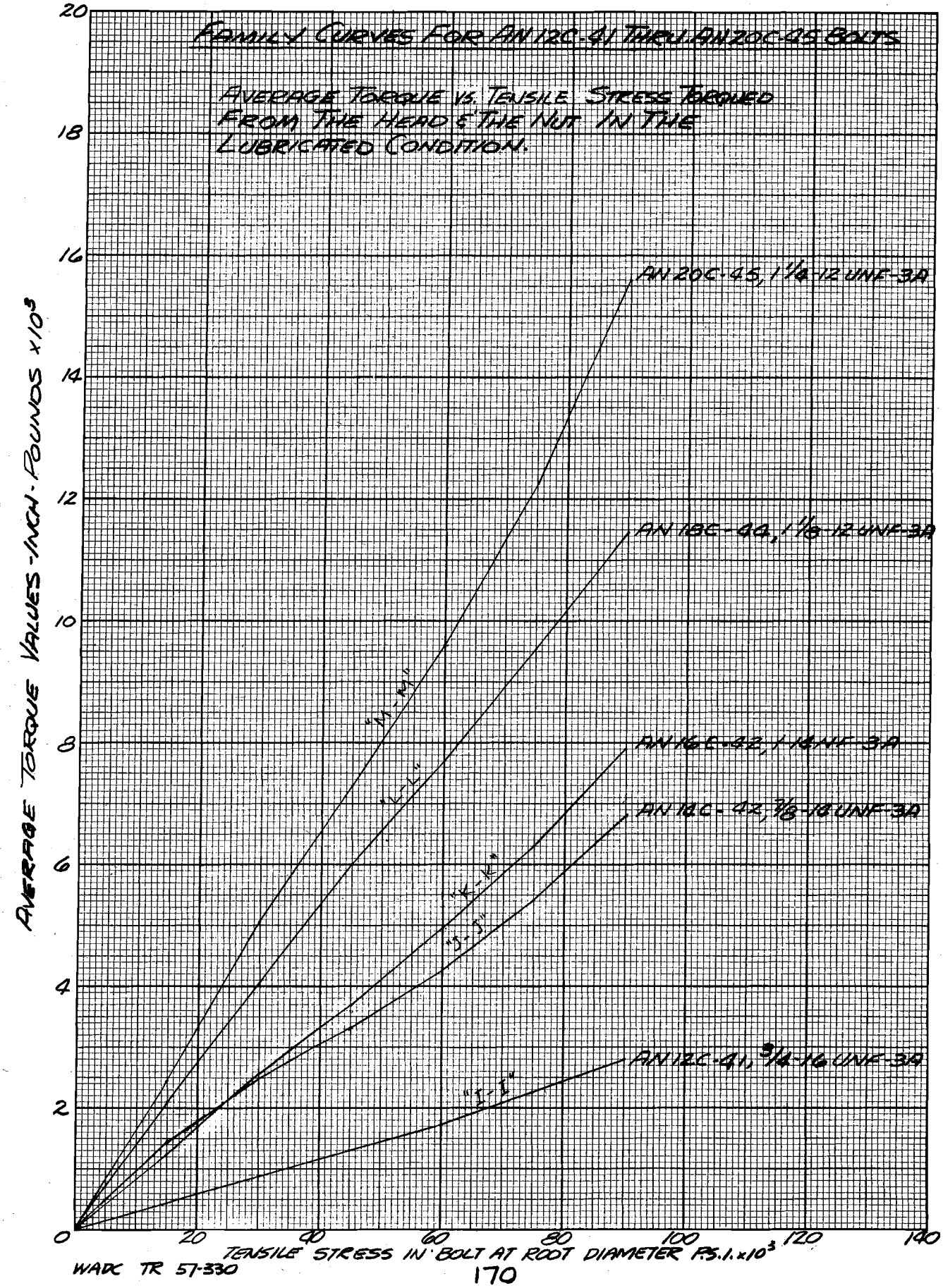



FAMILY CURVES FOR MS 20004 THRU MS 20010 BOLTS
AVERAGE TORQUE VS. TENSILE STRESS
TORQUED FROM THE HEAD & THE NUT
IN THE LUBRICATED CONDITION.
MS 20010-50
5/8-18 UNF-3A
MS 20009-50
9/16-18 UNF-3A
MS 20008-50
1/2-20 UNF-3A
MS 20007-50
7/16-20 UNF-3A
MS 20006-50
3/8-24 UNF-3A
MS 20005
5/16-24 UNF-3A
MS 20004-42
1/4-28 UNF-3A
"G"
"F"
"E"
"D"
"C"
"B"
"A"
AVERAGE TORQUE VALUES - INCH POUNDS X 10³
TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. x 10³
0
.2
.4
.6
.8
1
1.2
1.4
1.6
1.8
2
20
40
60
80
100
120
140


FAMILY CURVES FOR MS 20012 THRU MS 20022 BOLTS
AVERAGE TORQUE VS. TENSILE STRESS TORQUED FROM THE HEAD & THE NUT IN THE LUBRICATED CONDITION.
MS 20022-52 1 1/2-12 UNF-3A
MS 20022-52 1 3/8-12 UNF-3A
MS 20020-52 1 1/4-12 UNF-3A
MS 20018-52 1 1/8-12 UNF-3A
MS 20016-52 1-1/4 UNF-3A
MS 20014-52 7/8-14 UNF-3A
MS 20012-52 3/4-16 UNF-3A
"M"
"L"
"K"
"J"
"H"
AVERAGE TORQUE VALUES - INCH-POUNDS x 10 3
0
2
4
6
8
10
12
14
16
18
20
20
40
60
80
100
120
140
TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. x 10 3


FAMILY CURVES FOR AN 509-8R37 THRU AN 509-916R52 BOLTS.
AVERAGE TORQUE VS. TENSILE STRESS TORQUED FROM THE HEAD & THE NUT IN THE LUBRICATED CONDITION.
AN 509-916 R52
9/16-18 UNF-3A
AN 509-816 R49
1/2-20 UNF-3A
AN 509-716 R48
7/16-20 UNF-3A
AN 509-616 R48
3/8-24 UNF-3A
AN 509-516 R48
5/16-24 UNF-3A
AN 509-416 R37
1/4-28 UNF-3A
AN 509-10R37
10-32 NF-3A
AN 509-8R37
8-32 NF-3A
"W"
"U"
"T"
"S"
"R"
"P" & "X"
"O" & "N"
AVERAGE TORQUE VALUES - INCH - POUNDS x 10
0
12
24
36
48
60
72
84
96
108
120
20
40
60
80
100
120
140
TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. x 10³


FAMILY CURVES FOR AN 3C-30 THRU AN 10C-37 BOLTS
AVERAGE TORQUE VS. TENSILE STRESS
TORQUED FROM THE HEAD & THE NUT
IN THE LUBRICATED CONDITION.
AVERAGE TORQUE VALUES - INCH - POUNDS x 10³
TENSILE STRESS IN BOLT AT ROOT DIAMETER PS.I. x 10³
AN 10C-37, 5/8-18 UNF-3A
AN 9C-37, 9/16-18 UNF-3A
AN 8C-37, 1/2-UNF-3A
AN 7C-36, 7/16-20 UNF-3A
AN 6C-36, 3/8-24 UNF-3A
AN 5C-35, 5/16-24 UNF-3A
AN 4C-30, 1/4-28 UNF-3A
AN 3C-30, 10-32 NF-3A
"H-H"
"G-G"
"F-F"
"E-E"
"D-D"
"C-C"
"B-B"
"A-A"
0
.2
.4
.6
.8
1
1.2
1.4
1.6
1.8
2
20
40
60
80
100
120
140


FAMILY CURVES FOR AN 12C-41 THRU AN 20C-45 BOLTS
AVERAGE TORQUE VS. TENSILE STRESS TORQUED FROM THE HEAD & THE NUT IN THE LUBRICATED CONDITION.
AVERAGE TORQUE VALUES - INCH - POUNDS x10³
TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. x10³
AN 20C-45, 1 1/8-12 UNF-3A
AN 16C-44, 1 1/8-12 UNF-3A
AN 16C-42, 1-14 NF-3A
AN 12C-42, 7/8-14 UNF-3A
AN 12C-41, 3/4-16 UNF-3A
"H-H"
"G-G"
"F-F"
"E-E"
"D-D"
0
2
4
6
8
10
12
14
16
18
20
20
40
60
80
100
120
140

Family Curves for MS 20004-42 Thru MS 20010-50 Bolts

Average Torque vs. Tensile Stress

Dry Condition

Torqued From Head

1st Torquing

5th Torquing

Torqued From Nut

1st Torquing

5th Torquing

AVERAGE TORQUE - INCH LB. $\times 10^2$

TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. $\times 10^3$

FAMILY CURVES FOR MS 20012 ED THRU MS 20024-32 BOLTS

AVERAGE TORQUE VS TENSILE STRESS

DRY CONDITION

TORQUED FROM HEAD — 1ST TORQUING

TORQUED FROM HEAD — 5TH TORQUING

TORQUED FROM NUT — 1ST TORQUING

TORQUED FROM NUT — 5TH TORQUING

AVERAGE TORQUE - INCH LBS. $\times 10^3$

72
64
56
48
40
32
24
16
8

"N" "M" "L" "K" "J" "I" "H"

0 20 40 60 80 100 120

TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. $\times 10^3$

FAMILY CURVES FOR AN509-8R57 THRU AN509-916R52 BOLTS

AVERAGE TORQUE VS. TENSILE STRESS

— DRY CONDITION —

TORQUED FROM HEAD

1ST TORQUING

5TH TORQUING

TORQUED FROM NUT

1ST TORQUING

5TH TORQUING

AVERAGE TORQUE - INCH LBS. × 10^2

TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. × 10^3

Family Curves for AN3C-39 Thru AN10C-39 Bolts

Average Torque vs. Tensile Stress

Dry Condition

Torqued From Head

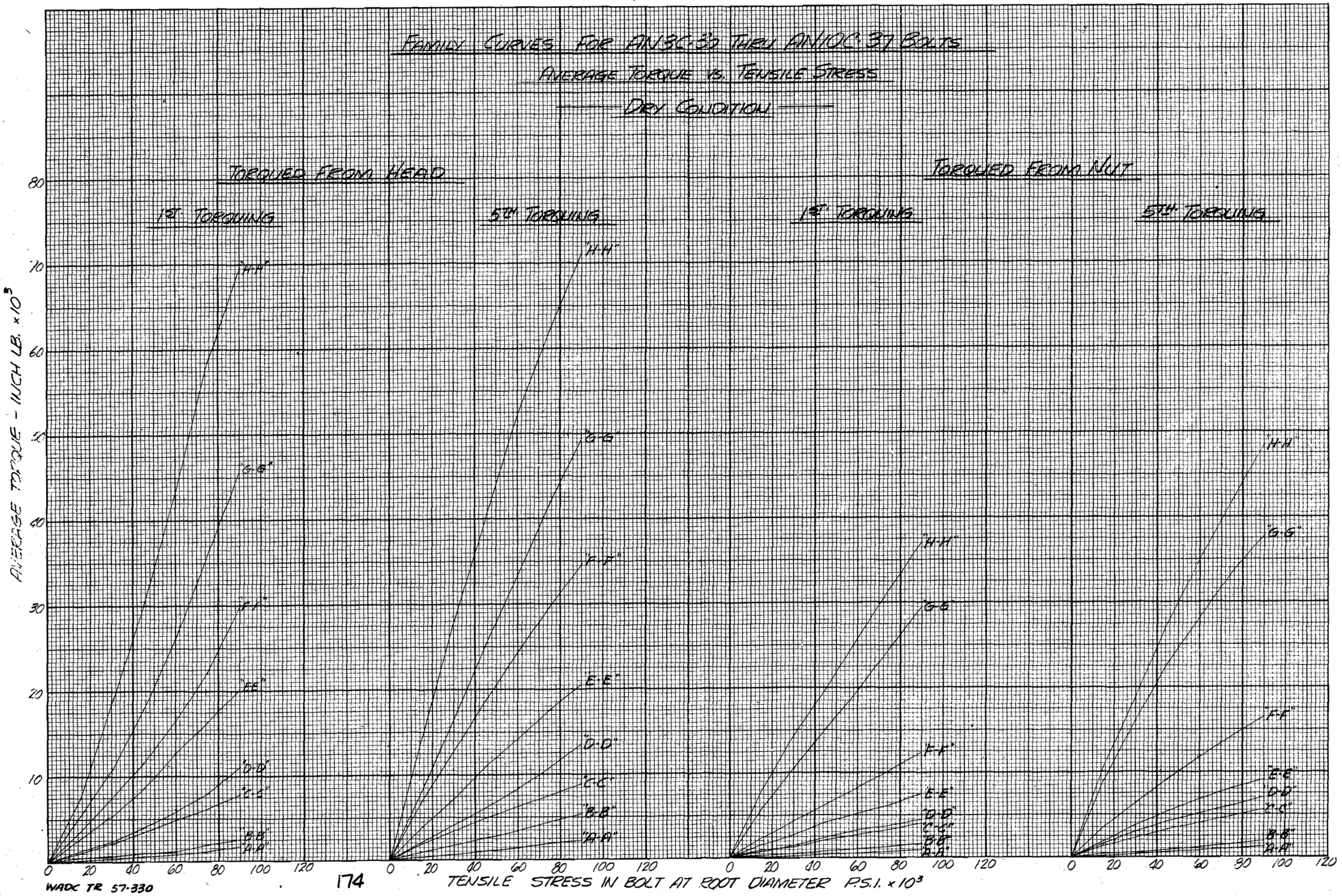
1st. Torquing

5th Torquing

Torqued From Nut

1st. Torquing

5th Torquing



Family Curves For AN3C-41 Thru AN20C-45 Bolts

Average Torque vs. Tensile Stress

— Dry Condition —

Torqued From Head

1st Torquing

5th Torquing

Torqued From Nut

1st Torquing

5th Torquing

AVERAGE TORQUE - INCH LBS. x 10^3

56
48
40
32
24
16
8

"M-M"
"L-L"
"K-K"
"J-J"
"I-I"

"M-M"
"L-L"
"K-K"
"J-J"
"I-I"

"M-M"
"L-L"
"K-K"
"J-J"
"I-I"

"M-M"
"L-L"
"K-K"
"J-J"
"I-I"

0 20 40 60 80 100 120

TENSILE STRESS IN BOLT AT ROOT DIAMETER P.S.I. x 10^3